MUNICIPAL ENGINEERING

VOLUME XLII NUMBER TWO

FEBRUARY, NINETEEN HUNDRED TWELVE

Practical Road Building.*

By John N. Edy, C. E., Highway Engineer, Billings, Mont.

CONSTRUCTION OF EARTH ROADS.

BY FAR the greater mileage of roads with which the supervisor has to contend is constructed of natural earth. Because of this fact and because such a road must inevitably be used as the foundation for future improvement, the construction and maintenance of the earth road is of vital importance to the taxpayer. The location of all roads having been previously treated, we are concerned chiefly with the construction and maintenance, with this exception: In building a road that has been in use for some time improvement by relocation should be considered. This relocation need not be applied to the entire route. There will be found places where the drainage may be improved, the distance shortened or grades eliminated by slightly changing the location. The making of a good earth road on an old roadbed must begin with this subject of relocation.

A. *Construction.*—Under this head we have: First, clearing, excavating and filling; second, building the foundation and wearing surface.

1. The right-of-way should be cleared throughout its entire width. This clearing might well be done by contract at so much per acre. The following table, showing acres per mile for different widths of right-of-way, will aid in estimating the cost of such work:

One mile of road—

1	foot	wide	contains	0.121 acres
10	feet	wide	contains	1.21 acres
20	feet	wide	contains	2.42 acres
30	feet	wide	contains	3.64 acres
40	feet	wide	contains	4.85 acres
50	feet	wide	contains	6.06 acres
60	feet	wide	contains	7.27 acres
70	feet	wide	contains	8.48 acres
80	feet	wide	contains	9.70 acres
100	feet	wide	contains	12.10 acres

No stumps should be left standing above the level of the road, and in the driveway the stumps should be entirely removed. For this purpose blasting is preferable to grubbing, the former method being both quicker and cheaper. All trees, logs, brush, etc., are to be removed from the right-of-way.

No excavation should be attempted until the work has been staked by an engineer, who will save many times his fee by balancing cuts and fills and eliminating unnecessary waste; slope stakes should be set, showing the cut or fill at both sides and in the center of the grade. It is of primary importance that the supervisor use the proper earth-moving machinery. Enough money is ordinarily wasted using the wrong tools to provide a first-class equipment. Every supervisor should own and use some practical book on earth excavation. In fact, the county would save money by furnishing these helps free of charge.

As a general thing it is economical to use slip or drag scrapers for distances up to 150 or 200 feet. With very small scrapers and strong teams consider using one horse to the scraper. This is more important where there is likely to be any delay in loading or dumping. For distances between 200 feet and 800 feet use wheel scrapers in sufficient number to provide a minimum loss of time. The writer suggests the use of Fresnoes for any distance up to 400 feet. This scraper is used largely in the West for all classes of work, especially in irrigation and highway cnstruction, and is considered the most economical dirt-moving device used. Eastern contractors and municipalities are losing money if they are not acquainted with the merits of this tool.

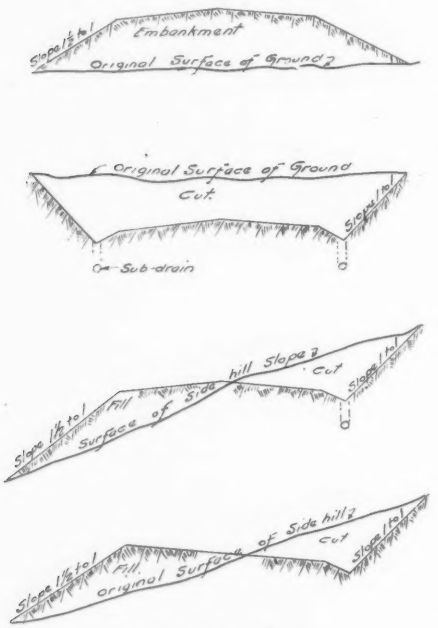
For hauls longer than 800 feet or 1,000 feet use slat-bottomed wagons, or, prefer-

*Copyright by John N. Edy.

ably, an improved dump wagon. In any case the crew should be arranged so that every man will be kept busy, a maximum amount of work being accomplished by teams with as little hand labor as possible. In hauling from a pit with just enough men to readily load one wagon do not have all teams report at the same time. Have them come into the pit, say, ten or fifteen minutes apart.

Other things being equal, the cost of all excavation depends absolutely on the ability and judgment of the foreman or superintendent.

Embankments should be built in layers of one foot by spreading the material for the full width of grade. If the earth is moist, as it will be in the spring, the passage of teams and scrapers or wagons will probably pack it sufficiently. In dry weather, working rapidly, the layers should be rolled. This may be done by using the home-made concrete roller described later. No stumps, brush or heavy vegetable matter should be permitted in the embankment, the sides of which should slope at the rate of 1½ feet horizontal to 1 foot vertical. In earth cuts the banks may slope 1 to 1.

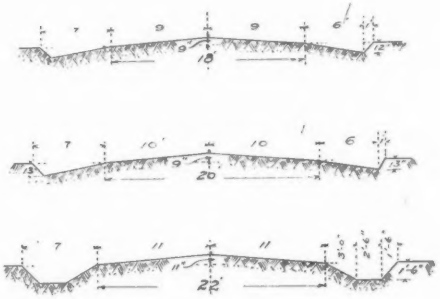


Earth Excavation

1. PREPARATION OF SUB-GRADE.
Excavation and Embankment.

The foundation of an earth road is prepared chiefly by providing drainage and compacting the material. In doing grader work it has been the practice to use the hard, firm surface of the old road for the foundation, and to build the wearing surface of a loose, porous mass of earth and sod. This is proper so far as the foundation is concerned, but we shall see that the surface should receive more attention than is usually given it. In order that we may adhere to the fundamental principles of road building as discussed in the November number, we must have both a dry, solid foundation and a solid and waterproof wearing surface; an attempt to do with the one without the other will result in the failure of the road.

The following sketches show some suggested cross-sections for roads that may be made with the grader. Note that the bottoms of the side ditches are about 2 feet below the crown of the road; that these ditches are wide and shallow; and that the surface of the roadway slopes at the rate of one inch per foot. Observe also the intercepting ditches used in deep cuts; they aid in keeping the banks dry, and thus prevent slides.



Earth Roads.

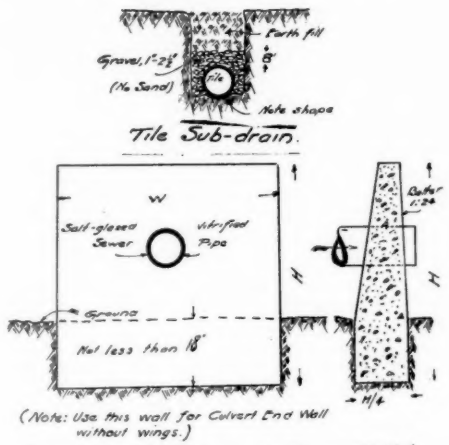
2. TYPICAL CROSS SECTIONS OF EARTH ROADS.

All grader work should be done in the spring when the soil is moist and will pack; when hard, dry earth is moved into the roadway it grinds into dust and readily absorbs moisture, thereby defeating the very purpose of the grading. If the old surface of the road is not firm, it should be thoroughly rolled, and all soft or spongy earth removed and replaced with good material.

While the drainage of the foundation will ordinarily be effected through the side ditches, it will sometimes be necessary to remedy "seepy" places, or underflow, by means of sub-drains, which are built as follows:

Locate, if possible, the source of the underflow and in the bottom of one side ditch (or both side ditches) dig a trench about 3 feet deep that will tap the wet place. A line of 4 or 6-inch drain tile,

laid closely, but with open joints, and having a fall of at least 3 inches per 100 feet, is placed in the trench, true to line and grade. No sharp turns are to be permitted, changes in direction to be effected by easy, gradual curves. Place carefully over and about the pipe about 12 inches of loose screened gravel or broken stone, and complete the back filling with well-tamped earth. An outlet must be provided, either into a side ditch or culvert, or through a bank. Exposed outlet pipe is to be of better grade than



3. DRAINAGE DETAILS.

ordinary drain tile, and must be protected by a head wall of concrete or stone masonry. If it is not possible to secure tile, a very serviceable drain may be constructed by setting two lines of flat stones on edge and covering with stones laid flat, forming an open stone box.

Under-drainage is of permanent value to the road; it is sometimes essential to a dry foundation. Sub-drains should be placed on one or both sides of the roadway, but never under the center, where they are practically inaccessible. Very little surface water finds its way into these drains, their real objects being:

1. To lower the water level in the soil.
2. To cut off the underflow.
3. To hasten the drying of the road after a thaw.

The earth wearing surface must be free from sod and other vegetable matter. If we are to have a "suitable, compact and waterproof" wearing surface the material must be carefully handled and every precaution exercised. The grader or other tool having moved the good earth toward the center of the road, the clods should be broken by harrowing, and the whole thoroughly rolled. During this process depressions and unevenness in the surface will develop, when material should be added where necessary and again rolled until the surface is uniform and conforms to the cross-section adopted. In using the roller begin at the side ditches and roll in the direction of the length of the road, working nearer the center; roll both sides before rolling the center of the road.

Note that on steep grades the crown should be designed to enable the water to run to the side ditches, rather than along the road. Ditches should be paved to prevent wash. No water breaks should be built across the roadway. In order to remove the water from the side ditches carry it under the road at frequent intervals. Earth roads require plenty of sunshine, and shrubbery that interferes with the proper drying of the road should be removed. Occasionally on steep grades in side-hill work, instead of elevating the center of the road, it may be desirable to raise the outer side, slanting the whole surface in toward the ditch on the inner side. This is a help to teams when the road is in a slippery condition, especially at sharp turns.

4. DRAINAGE CANAL BEFORE CONSTRUCTION OF ROAD ON EMBANKMENT.

All side ditches should be left smooth and in such condition as to offer the least resistance to the flow of water. Particular attention must be given the grade of these ditches, insuring the removal of all water that falls on the roadway and that comes on the right-of-way from adjacent land. A minimum grade of ½ per cent., or a fall of 6 inches in 100 feet, is suggested. It is sometimes necessary to use the road ditch as a sort of lateral

drainage ditch for low, swampy land, in which case the dimensions of the waterway must be determined to suit the conditions.

Where drainage canals have been dug through wet land, it is often convenient to build a road on one bank of the canal. For this reason during the construction of the canal all stumps excavated should be placed on one side of the ditch, leaving the other bank free from obstructions. A bank similar to the one shown in the accompanying photograph was graded with plow and drag and made into a serviceable roadway 22 feet wide for $70.00 per mile. (See Fig. 4).

When it is found necessary to construct a road through a swamp some means must be adopted to prevent disastrous settling of the material. A very common method is to lay logs and poles crosswise of the road, covering with a layer of brush, on which the earth fill is placed; the object being to place the roadway above the water, and to prevent its settling into and becoming a part of the wet and unstable sub-grade. Another plan is to throw large rock into the side ditches, confining the material under the roadway and thus increasing its bearing power. Willow mattresses placed on the soft ground have been used to distribute the load. Each case of this nature usually presents a problem in itself, and must be solved by the experience and ingenuity of the supervisor.

Tannery Wastes in Sewage.

WHILE litigation over tannery wastes in sewage is not widespread, the growing disposition of the public to seek damages and to enforce purification makes the subject of the inoffensive disposition of such wastes a matter of by no means remote interest to the tanning industry in general. Gloversville, N. Y., the center of the glove industry in this country, has a particularly lively experience with damage suits against the tanneries there, and under pressure of adverse verdicts, backed by an extensible injunction, the city has had to devise a new system of sewage disposal. A report on the matter, by Harrison P. Eddy, civil engineer of Boston, and Morrell Vrooman, city engineer of Gloversville, who were assisted by H. B. Hommon, chemist, sets forth certain features of the new system that are likely to be imitated in other tanning centers whenever the question of sewage disposal becomes acute.

In addition to the glove manufactories, Gloversville has 26 tanneries at which glove leather and the finer grades of shoe leather are prepared. There is also one hair mill, where the hair from the wastes of the various tanneries is recovered, besides knitting and silk mills and one brewery. All of the domestic sewage, tannery refuse and mill wastes were formerly emptied into the adjoining creek, and it was by riparian owners on this creek that the successful litigation was begun.

The gross weight of wet and dry hides tanned in Gloversville annually amounts to 9,,000,000 lbs. and about 8,000,000 lbs. of chemical reagents and other substances are used in the process. The waste liquors from this process contain spent chemicals, more or less of the active reagents, as it is not possible to completely exhaust the solutions, together with large quantities of hair, bits of flesh and dirt.

The shrinkage of weight in hides during the process of tanning probably amounts to not less than 50 per cent., or 4,500,000 lbs. per year. It is also probably true that 50 per cent. of the chemicals and other agents employed in the process of tanning are carried away from the tanneries in the form of refuse. The only process which is employed to recover any portion of these wastes is that carried on at the hair mill for the recovery of the hair. While over 6,000,000 lbs. of wastes are annually conveyed to the hair mill, only a comparatively small portion of these wastes is recovered in the form of hair. Much of the balance, together with chemicals from the exhausted tanks, constitute a part of the sewage.

Analyses of the creek water indicate that the quantity of wastes which finds its way from the tanneries to the creek averages over 30,000 lbs. per day, or 9,-000,000 lbs. per year. From the studies that have been made, it appears that fully one-half of the total weight of hides and chemicals used in the process of tanning eventually finds its way into the creek. This is undoubtedly a low estimate of the total amount of solid and liquid wastes, for the reason that considerable portions are of such a nature that they do not readily flow along with the water and may not, therefore be included in the samples. At nearly every tannery are to be seen large quantities of lime

and other refuse which have been dumped out upon the land, much of which could not be included in the samples analyzed, although some is washed into the creek in times of storm. The liquid wastes from the various tanneries and the hair mill contain not only large quantities of impurities in solution, but also much matter in suspension.

As the admission of the tannery wastes without the removal of any portion of the matters in suspension would not only place upon the purification plant a heavy burden for the disposal of sludge, but also might cause considerable deposit in the intercepting sewer, the city council passed an ordinance requiring all wastes from the tanneries to be passed through settling tanks before they were discharged into the intercepting sewer. Some of the interesting sections of this ordinance are as follows:

"No mill, factory or other manufacturing establishment having mill waste shall use the sewer system of the city of Gloversville for sewering purposes without first connecting said mill, factory or other manufacturing establishment with settling tanks.

"The purpose of the tanks at the mills is to remove the suspended solids, hair, leather and other heavy material from the mill wastes by sedimentation, and any chemical or biological action that may take place in the tanks, so that the combined mill and domestic sewage may be purified; also to avoid the clogging of city sewers or unnecessarily burdening the sewage disposal plant.

"The size of the tanks to be constructed or used at any mill that is connected with the sewer system of the city of Gloversville shall be sufficient for the purpose for which they are intended, and they shall be constructed with such features and of such dimensions as may be required by the common council.

"Tanks must be regularly cleaned at such intervals as their operation proves necessary or at any time when the city engineer deems they should be cleaned. In cleaning the tanks no solids shall be emptied into the sewer or outlet from the tanks, nor in any other way shall solids from the tanks be permitted to enter the sewer in cleaning. If the tanks are not properly cared for or if they are not cleaned when necessary or when directed by the city engineer, they will be cleaned by the city and the expense thereof charged to the owner of the mill.

"Free access to the tanks must be given to the common council or their representatives at any time for either the purpose of measurement, analysis, experiments or inspection, or for any other purpose connected with the operation or regulation of said sewer system."

It has been found when the tanks are kept properly cleaned that their efficiency is very satisfactory. Occasionally the quantity of suspended matter is slight, while at other times it is very high, occasionally exceeding 2,500 parts per million. Over 90 per cent. of the suspended matter has been removed in some cases, and it appears that there will be little difficulty in maintaining an average efficiency of 70 per cent. in all cases. If an efficiency of 90 per cent. could be maintained, all of the effluents would pass a standard of 300 parts per million of suspended matter. Difficulty has been experienced in securing the full co-operation of some of the mill owners in cleaning the tanks, so that the results of this preliminary treatment have not been as satisfactory as had been hoped. It has been found necessary to establish a systematic inspection of the tanks, and to require the owners to clean them whenever the accumulation of sludge is so great as to interfere with their efficiency.

It has been found that a single tank has retained over 8,000 pounds of sludge (10 per cent. solids) in a single day, and in several cases from 3,000 to 3,500 pounds has accumulated in the same length of time. As a result of tests made at one time, it was found that the tannery wastes contained as much as 61,600 pounds of sludge in a single day, and that of this amount over 26,000 pounds were retained in the mill tanks. Had a uniform efficiency of 70 per cent. removal been secured, over 43,000 pounds of sludge would have been produced.

After removal of a large part of the suspended matter in the settling tanks built by the tanneries the sewage at Gloversville was subjected to experimental purification by means of sedimentation and septic tanks, sprinkling filters and then further sedimentation, followed by sand filtration. The important point established by these processes was the fact that the chemicals in the tannery sewage did not prevent bacterial purification, though such action was perhaps somewhat retarded.

Undoubtedly the most striking result of the whole investigation by Messrs. Eddy and Vrooman is the establishing of the fact that by the use of settling tanks at the tanneries the sewage from these places could be made to contain a low proportion of suspended matter, so that they conformed nearly to the standard of ordinary domestic sewage. This fact is of practical importance to every tannery which has to consider actual or prospective litigation over the disposal of its wastes.

Stone Pavements of England and America.

By Ernest Flagg.

THE street pavements of American cities are as much inferior to those of Europe as our country roads are inferior to the roads of Europe.

To one who has not made a study of the subject it would seem incredible that there could be such a difference between them.

Not only are our pavements poor beyond what could be thought possible in Europe, but their cost both for construction and maintenance is all out of proportion to their worth.

The pavements of New York may be taken as typical of those of most other American cities. They consist generally of stone blocks, mastic asphalt, wood, brick, compressed asphalt blocks, etc.

The stone pavements are made of what are called Belgian blocks. These are large, roughly shaped pieces of stone, varying in width from 4 to 5 inches and in depth from 8 to 9 inches. (See Figure 1.) They are often laid on the bare earth in a bed of sand, but in pavements of the best sort they have a concrete foundation about six inches thick, which is not always made of the best material. Upon this foundation the stones are laid in a bed of sand from one to two inches thick.

The curbs which line the roadway are not usually laid by the municipality, and they vary in kind, size and quality.

The cross-walks are made of large pieces of stone, which are generally so soft and have such wide joints that wheels soon work in between them, rounding off the edges and making ruts.

After the paving blocks are laid gravel is spread over them and brushed into the joints, which are then grouted with hot pitch; but the stones are so large that the pitch cools before it can reach the bottom of the joint and does not impregnate the sand bed below. Even if the pavement is impervious at the start, it ceases to be so and water entering between the stones, disturbs the sand and causes depressions in the surface, which rapidly spread under the blows of traffic. The irregular shape of the stones and their great size cause them to ride or tilt when struck by heavy loads, thus aggravating the mischief. The joints are so wide that wheels soon find their way into them.

When steel strikes a stone the stone gives way; and it is not uncommon to see the surface of these pavements covered with granite powder formed by a single day's wear, indicating the rapid rate of disintegration.

Such a pavement is full of slight irregularities at the start, which makes it disagreeable to pass over even when new, and after three years of heavy traffic it is not fit for use. This is a fair description of our best type of stone pavement.

I was more impressed by the contrast which the stone pavements of the cities of England presented to ours than by anything else I saw when abroad which related to roadways. My automobile met me at the dock at Liverpool, and as it rolled onto the stone pavement I could hardly credit my senses, so different was the sensation from what it would have been at home in driving over a pavement of this kind.

To all appearances the pavement was like ours, but the automobile passed over it as smoothly as if it were made of newly laid brick or asphalt; the disagreeable irregularities of our stone pavements were entirely lacking. My curiosity was aroused, and I drove my car for many miles through the city and, to my astonishment, found everywhere the same true and even surfaces. Not a rut nor a hole did I see, but on every street the same smooth roadway. I looked up a city engineer to find out how it was done.

I asked him how it was possible to keep all the streets free from ruts and holes such as one sees here on every block. He smiled as he said: "A ratepayer in Liverpool would not for a minute stand for a hole in the pavement in front of his property."

Happy ratepayer who has a government responsive to his rights!

I thought of our free country and had visions of what would happen to a property-owner here who refused to pay taxes because his pavement had holes in it.

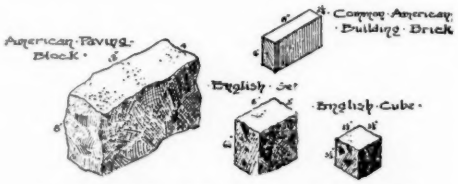
I tried to find out what caused the surprising smoothness of the stone surface, but even after the engineer's explanation it was some time before I could account for it. The method of laying seemed quite ordinary to him, and his description of the way it was done appeared to tally exactly with ours.

I found the secret lay in the very small and uniform size of the blocks used, in the fineness of the joints, the thinness of the sand bed, the excellence of the foundation, the great care used to keep all rails and manhole covers absolutely flush

with the surface, in the substantial character of the curbs and channels, and in the wonderful toughness of the material used.

I was told that the traffic of Liverpool is the heaviest in the world, and judging from the prodigious size of the loads I saw, I could well believe it.

The wheels of the drays are all small, not small in front and large behind as here, and the platform extends over them,



1. ENGLISH AND AMERICAN PAVING BLOCKS CONTRASTED WITH BUILDING BRICK.

so that, although the distance from outside to outside of hub is no greater than with us, the floor area is half again as large and more than twice as serviceable. The average weight of the horses seemed twice that of ours, and one sees, on every hand, single horses hauling loads that would require three horses here. Teamloads weigh from eight to twelve tons, as against three to five here.

Under this terrific traffic the pavements of Liverpool stand from twenty to thirty years, and as I have said, I was unable to find any depressions, irregularities or other signs of failure in them anywhere, although I made a pretty thorough search.

The stone pavements of Liverpool are of two kinds.

Most of the streets are paved with little cubes of granite of three and a half inches in every dimension, or not as large cubically as an ordinary brick. (See Figure 1.) These are cut like ours with a hammer, but with such regularity that the greatest permitted variation in size is only one-quarter of an inch. They are laid in a half-inch bed of sand on a six-inch foundation of the best concrete. The joints are limited to one-quarter of an inch. They are covered with shingle, then grouted with hot pitch. The stone being so small, the pitch finds its way not only to the bottom of the joint, but into the sand bed, which it thoroughly impregnates, so that the pavement becomes absolutely impervious (see Figure 2).

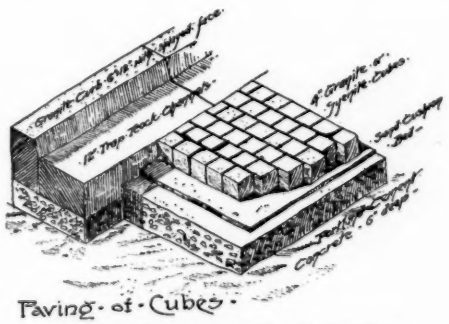
For the streets exposed to the greatest wear the engineers prefer what are called sets. These are oblong blocks three and a quarter inches wide by six and a quarter inches deep, and from five to seven inches long, laid in the same way; but, so far as I could see, the cubes answered just as well and made even a smoother pavement than the sets (see Figure 3).

ECONOMY OF GOOD PAVEMENTS.

Mr. Bulnois, formerly city engineer of Liverpool, says that when these impervious granite pavements were first introduced Liverpool had 200 miles of pavement, which cost for maintenance £38,280 ($185,275), and for interest and sinking fund £15,756 ($76,303), making the total cost per mile £270 ($1,307), whereas twenty-two years later, when the city had 258 miles of pavement, the annual maintenance cost was only £14,205 ($68,752), and the interest and sinking fund was £36,917 ($178,678), making the total cost per mile £198 ($959). Thus the excellent pavements of the present day are costing the city 26 per cent. less per mile than the poor ones which they replaced.

I have no doubt that the general introduction of similar pavements here would result in a corresponding saving to New York City. But the saving to the city would be one of the least of the benefits which would accrue from them. The saving in the cost of moving merchandise through the streets and in lessening of the wear and tear on vehicles would be monumental in comparison to it.

Before seeing the pavements of England I had always regarded stone pavements as the worst possible kind, but after my experience there my views have changed, and I now regard them, when properly made, as undoubtedly the best for any place where traffic is heavy.



2. TYPICAL LIVERPOOL PAVEMENT.

We all know what a perfect pavement brick makes when it is newly laid. It is pleasant to ride over and affords an excellent footing for horses. The objection to it is that it cannot stand much traffic and soon wears out. The stone pavements of Liverpool have all the good qualities of brick without its one defect.

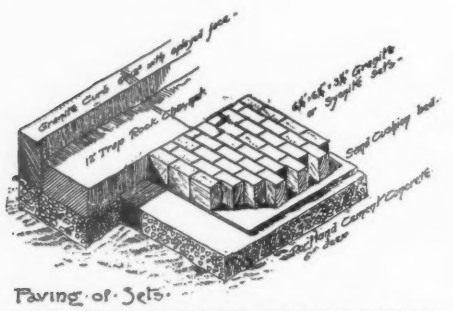
The stones—even when sets are used—are hardly larger than bricks (see Figure 1), and the surface formed by them is almost as true, but being made of the toughest kind of stone, they are harder than any artificial substance can be and therefore do not wear out like brick.

It is interesting to see how the use of a little common sense in construction can make such an amazing difference in the wearing quality and utility of pavements apparently so similar as the stone pavements of New York and Liverpool; and it is extraordinary that two cities which are in such constant communication as these should be so far apart in the condition of their streets.

During the last forty years we have made no progress here in our methods of stone paving. The specifications today are practically the same as they were in 1869, when Broadway was first paved with what we call Belgian blocks. Since that time the paving methods of Europe have made great progress, of which the statement of Mr. Bulnois, which I have quoted, is an illustration.

Stone as large as we use went out of use in England and France early in the last century, since which time the tendency has constantly been toward smaller sizes and a more uniform cut (see Figure 1).

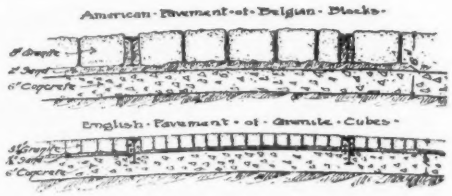
A short time ago specifications were gotten out for 25,000 square yards of granite pavement for Webster avenue in the Bronx, New York City, upon the regulation specifications. The old stones were to be discarded and new ones supplied in their place.



3. TYPICAL LIVERPOOL HEAVY TRAFFIC PAVEMENT.

The successful bidder for the work offered to take $20,000 off his bid if he might be allowed to split the old blocks and use them again. He guaranteed a better job than if new stone was supplied, and called attention to the fact that blocks of smaller dimensions were used everywhere but here, and that when the old blocks were cut in two the wearing blocks which were being used on another surface would still be more than twice as thick as the much softer composition part of the same street.

After a good deal of hesitation he was allowed to use the old stone, and although the pavement is far from perfect and so irregular that it would be thought but a



4. TYPICAL ENGLISH AND AMERICAN BLOCK STONE PAVEMENTS.

sorry job in England, still it is probably the best piece of stone pavement we have in the city today.

One might suppose from the greatly superior wearing qualities of the Liverpool pavements that they were more massive than ours, but they are really thinner and require less material to build; where sets are used they are thirteen inches thick, including foundations, and where cubes are used, only ten inches thick. Our pavements are from fourteen to sixteen inches thick. The superiority of the English pavements lies in their design and in the better quality of workmanship used in making them.

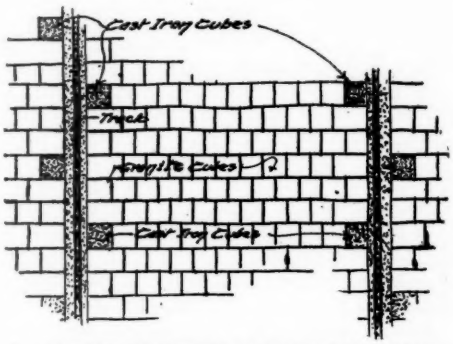
OUR ROUGH PAVEMENTS.

We are very careless in the building of pavements and in the selection of material for them, and seem to think that any kind of workmanship is good enough. They lack that true, substantial, well-made appearance which is characteristic of English pavements.

We appear to think that pavements should be rough and actually seem to go out of our way to make them so. Manhole covers are not laid flush with the stones, and even the covers are often not set flush with the rims. On Broadway, New York City, many of the covers are more than two inches below the rims. Car tracks here, even where the best kind of rails are used, are generally set considerably below the stone, forming ruts all along the tracks, whereas in European countries, and especially in England, the greatest care is taken to keep the contour of the roadway true in every part and the rails absolutely flush with the pavement; and so perfectly is this done, and so truly is the contour of the road preserved, that it is just as agreeable to drive over the rails as over any other part of the street surface (see Figure 4).

In Liverpool experiments extending over ten years on streets where the traffic is greatest have shown that the rails wear away faster than the stone, so if there is to be any difference in level the tracks should be raised slightly rather than depressed.

One very important detail which seems to be entirely overlooked here is lateral support for the blocks which line the car rail on either side of it. There is a concavity along the rails which should be carefully filled in with concrete before the blocks are laid (see Figure 4), otherwise the abutting blocks will have no lateral support and will soon break down. I have seen innumerable instances here where this has occurred. In fact, it can be seen almost wherever rails are found in connection with pavements which have been down a few years.



5. PAVING BETWEEN CAR TRACKS SHOWING CAST IRON BLOCKS.

In Liverpool the greatest care is taken not only to give the necessary lateral support to the stones which line the tracks, but also to break the continuous joint along them. This is done by making every fourth or fifth block which adjoins the rails of cast iron (see Figure 5).

Another detail which adds wonderfully to the fine and substantial appearance of English pavements is the massive granite curbs and channels which form the borders (see Figures 2 and 3). These are supplied and set by the municipality, not by the abutting property owners, as with us, and they are generally uniform for the whole city. They give a finish and an appearance of solidity to the pavement which is entirely lacking here. These curbs and channels are of cut granite and are so well laid that they are as solid and substantial as they are good-looking. Indeed, the whole pavement presents a fine, workmanlike appearance which it is a pleasure to see.

The chief reason for the long wear of the English pavements lies in their smoothness. They are so smooth that there is no chance for the wheels to strike and wear away the stone, and the material used is so tough that it wears actually better than iron. This was shown in tests of the wear of tramway tracks already referred to. "It was found from actual measurements and weights that in ten years the wearing surface or treads of Bessemer steel rails had worn down half an inch under tramway traffic of 318,689 tons per annum on each rail. The abutting syenite sets showed very little wear except where the edges next to the steel rails were rounded off."—*The Century Magazine.*

The Park Heights Experimental Road, Baltimore, Md.

By D. M. Avey, Indianapolis, Ind.

AN experimental stretch of road, known as the Park Heights road, and comprising twenty-nine sections, upon which fifteen different road compounds were used, was constructed near Baltimore, Md., in 1909. This road, which was built under the direction of Major W. W. Crosby, chief engineer of the Maryland State Roads Commission, has been carefully maintained and repaired, and regular inspections have been made to determine the progress of the experiment. A full report of the method of constructing the road was made by Major Crosby before the second International Road Congress, and has been published at various times.

The method of construction differs only in minor details throughout the road, the base being constructed according to the regular manner of building a macadam road. The binding material was applied by the penetration method to the clean rolled second course, though in some instances a layer of sand was applied to the rolled second course and rolled so as to partly fill the voids, before the application of the material with which the road was treated.

The Park Heights road is particularly adapted to use as an experimental road, being 8¼ miles in length and extending from the city limits into the country in such a manner that the traffic varies from that which is very heavy at the city end to the very light and infrequent at a distance of seven or eight miles out. The experimental sections have been so dis-

tributed that a comparison of the same materials under different conditions of traffic is possible.

The following traffic count over the different sections was prepared by Major Crosby and presented, together with some data on quantities and cost, before the American Society of Civil Engineers. The figures are averages per day of 12 hours:

SECTION NO. 1, CITY END.

One-horse vehicles	254
Two-horse vehicles	104
Three-horse vehicles	10
Four-horse vehicles	14
Six (or more) horse vehicles	1
Motorcycles	8
Motor runabouts	26
Motor touring cars (4 or 5 seats)	141
Motor touring cars (6 or 7 seats)	66
Motor wagons	4

SECTIONS NOS. 1 TO 3, INCLUSIVE.

One-horse vehicles	195
Two-horse vehicles	101
Three-horse vehicles	3
Four-horse vehicles	19
Six (or more) horse vehicles	1
Motorcycles	5
Motor runabouts	15
Motor touring cars (4 or 5 seats)	141
Motor touring cars (6 or 7 seats)	55
Motor wagons	7

SECTIONS NOS. 14 AND 15.

One-horse vehicles	52
Two-horse vehicles	23
Three-horse vehicles	3
Four-horse vehicles	4
Six-horse vehicles	1
Motorcycles	7
Motor runabouts	11
Motor touring cars (4 or 5 seats)	94
Motor touring cars (6 or 7 seats)	39
Motor wagons	3

SECTIONS NOS. 16 AND 17.

One-horse vehicles	31
Two-horse vehicles	19
Three-horse vehicles	3
Four-horse vehicles	1
Six-horse vehicles	1
Motorcycles	3
Motor runabouts	6
Motor touring cars (4 or 5 seats)	69
Motor touring cars (6 or 7 seats)	40
Motor wagons	4

The following table of construction and maintenance cost and quantities of material was compiled by Major Crosby and presented to the American Society of Civil Engineers, January 21, 1911, with the exception of the last sections, the data on which are supplementary:

TABLE OF QUANTITIES AND COST ON THE PARK HEIGHTS ROAD.

Section No.	Material Used	Time when Used	Quantities Gal. per yard	Cost per square yard of reaurfacing macadam	Cost of pitching, including chipping	Cost per square yard of maintenance to 1-1-11	Total cost per square yard of treatment to 1-1-11	Total cost per square yard of road surface to 1-1-11
1	Texaco	7 and 8/09	2.8	$0.337	$0.327	$0.088	$0.415	$0.752
2	Gulf	8 and 9/09	3.97	0.339	0.434	0.080	0.514	0.853
3	Texas	9/09	3.22	0.336	0.418	0.187	0.605	0.941
4	Fairfield	9/09	3.67	0.337	0.449	0.081	0.530	0.867
5	U. G. I.	9/09	3.12	0.339	0.344	0.081	0.425	0.764
6	Warren	9 and 10/09	4.19	0.333	0.606	0.079	0.685	1.018
7	Tarvia	10/09	5.4	0.337	0.618	0.082	0.700	1.037
8	Tarite	10/09	4.41	0.336	0.605	0.080	0.685	1.021
9	U. G. I.	11/09	4.46	0.340	0.454	0.091	0.545	0.885
10	U. G. I.	5 and 6/10	1.42	0.397	0.242	.....	0.639	.....
11	Texas	6/10	1.25	0.397	0.264	.....	0.661	.....
11-A	Mixed Tar	6/10	1.65	0.397	0.262	.....	0.659	.....
12	Headley	6 and 7/10	1.7	0.397	0.327	.....	0.724	.....
13	B. A. P.	7 and 8/10	1.45	0.397	0.325	.....	0.722	.....
14	Fairfield	8 and 9/10	1.65	0.397	0.292	.....	0.689	.....
15	Fairfield	10/10	0.60	0.397	0.084	.....	0.481	.....
16	U. G. I.	9 and 10/10	0.94	0.397	0.140	.....	0.537	.....
17	Sarco	1910	1.42	.....	.....	.....	.....	.....
18	Standard	1910	1.7	.....	.....	.....	.....	.....
19	Standard	11/09	3.92	0.241	0.174	0.087	0.261	0.502
20	U. G. I.	10/09	3.86	0.230	0.408	0.088	0.496	0.726
21	Texas	10/09	4.7	0.228	0.551	0.088	0.639	0.867
22	Gulf	10/09	2.95	0.229	0.405	0.082	0.487	0.716
23	Warren	10/09	4.71	0.224	0.691	0.082	0.773	0.997
24	U. G. I.	9/09	2.23	0.229	0.257	0.081	0.338	0.567
25	Fairfield	9/09	2.73	0.228	0.353	0.057	0.410	0.638
26-27	Local & U. G. I.	8/09	2.98	0.216	0.303	0.057	0.360	0.576
28	Texaco (special)	.....	.....	.....	.....	.....	.....	.....
29	Glutrin	.....	0.43	.....	.....	.....	.....	.....

The progress of the experiment has been the subject of comment at various times since the construction of the road, but up to the present time the results do not warrant a comparison of the various classes of materials used. During the summer of 1911 the writer, in company with a representative from the Maryland Highway Commission office, made an inspection of the road, and noted the points which are set forth in the following. Although no full comparison can be given until the road has seen two or three more years of service, yet there are in a number of cases special defects or merits which indicate the value of the material used.

Section 1. The Texas Company. Texaco.

This section was constructed in the summer of 1909, and the material used was a Texas asphalt manufactured by The Texas Company. The application was made with buckets, and evidently too much of the material was used; as, even at the time of inspection two years after the construction of the road, the material was flushing to the surface.

Section 2. Gulf Refining Company. Asphalt oil "A."

The surface of this section was badly rutted, and large stones had been loosened from the road bed, causing the formation of hollows, which, in some cases, were two feet by three or more feet in size, extending transversely across the road.

Section 3. The Texas Company. Texas Road Asphalt.

This section of road was, at the time of inspection, undergoing a complete resurfacing, owing to the fact that the binder seemed to have entirely lost its cementing power, allowing the surface to ravel. It is due, in fairness to the manufacturers of this binder, to say that the construction of section 3 was not satisfactory, either to Major Crosby, or to The Texas Company. The difficulties were due partly to the amount of material which was used and partly to the consistency of the same. The material which was being used in resurfacing the section was a heavy grade of road asphalt, mixed by the penetration method, about one and one-half to two gallons per square yard being used.

Section 4. Impervious Products Company. Fairfield.

There was a great excess of bituminous material in this section; and the surface showed plainly the marks of horses' hoofs. It was not rutted, however, and was smooth and in excellent condition otherwise.

Section 5. United Gas Improvement Company. No. 4.

This section, though given a heavy treatment, showed no evidences of bleeding, nor was any surplus material in evidence along the shoulders of the roadway. The surface was hard, smooth and in excellent condition.

1. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 11. The Texas Co.

Section 6. Warren Brothers. Puritan Brand No. 10.

A peculiar condition was evident in this section. The surface had formed into rolls; and the material, both binder and aggregate, had pushed out over the shoulders. The binder seemed dead, and the larger stones were becoming loosened from the surface.

Section 7. Barrett Manufacturing Company. Tarvia.

In this section the dead condition of the binder in the center of the roadway was almost as evident as in the preceding section; but the stones were held firmly in place, and the surface was hard and smooth. A quantity of the binder had exuded from the surface and flowed to the sides of the roadway. This mate-

rial did not have the dead properties of that at the center of the road, but possessed plasticity and binding qualities.

Section 8. American Tar Company. Tarite.

The surface of this section had become rolled into transverse ridges, and the binder was elastic, but dead. The flush coat appeared to have run towards the shoulders, but disintegration had not commenced.

Section 9. United Gas Improvement Company. 1909 construction.

Section 10. United Gas Improvement Company. 1910 construction.

These two sections should properly be considered together, as it was stated that the same grade of material was applied under identical conditions, the only difference being in the quantity of binder used. The 1909 work, though it was constructed with 4.46 gallons of binder per square yard, was smooth, hard and in excellent condition. The 1910 section, on which 1.42 gallons of binder were used, showed evidences of bleeding, the surface containing small waves where the excess material had collected; and in other ways was not in as good condition as that which was constructed the previous year. It is probable that some unmentioned detail of construction caused this condition, or else that, under the rolling effect of the traffic, the surface will be improved.

Section 11. The Texas Company. Road Asphalt.

Photograph No. 1 shows the condition of this section. The surface was, for the greater part, hard and smooth with no excess of binder. Some material had pushed out at the side of the road; but for the most part there was no evidence of bleeding over the roadway. The binder was apparently in as good condition as that which was being taken from the barrels to repair section 3.

Section 12. 11 A. Fifty-two barrels of mixed material.

This haphazard mixture of various materials was in fair condition, though the surface was soft and gave evidence of bleeding.

Section 12. Headley Manufacturing Company. Road asphalt.

There was a great quantity of surplus binder evident on the surface of this section, and chips had been used to relieve the condition. The material was so sticky as to give a sharp smacking sound, due to its adhesion to the tires of passing automobiles.

Section 13. Barber Asphalt Paving Company. Road asphalt.

There were two divisions to this section, different grades of material being used. The surface in both cases was in good condition. In the case of the heavier grade of material there was a slight evidence of surplus binder; but it was by no means an objectionable quantity. The lighter binder was holding firmly, and the surface was hard and smooth.

2. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 15. Fairfield Antidust.

Section 14. Fairfield tar.

This section was broken off at the shoulders where vehicles had passed over the edges, and patches had been placed in a number of places. The surface at the time the inspection was made was in fair condition, there being no evidences of raveling or bleeding.

Section 15. Fairfield Antidust.

The chemical content of the material used is not available, but in this action it resembles a road material produced from a refuse of wood pulp. The road was hard, dustless and smooth; but had been patched in a few places. The surface had a brownish appearance similar to concrete which had been covered with iron rust. Photograph No. 2 shows this section.

Section 16. United Gas Improvement Company. Antidust.

This section, which was treated with a surface coat of the above material, was one of the best noted up to that point. It was smooth, hard and with no dust or particles of any sort upon the surface. The top coat seemed to be crystalized; and only a narrow line was made when the surface was scratched with a knife blade. Photograph No. 3 shows the smoothness of the surface.

Section 17. Standard Asphalt and Rubber Company. Sarco.

The faults in this section appeared to be due entirely to the method of construction rather than to the material used. The surface has the appearance of a terrazzo floor, was firm and dustless; and, except for a few patches, showed no signs of bleeding. The shoulders on one portion of the road were breaking slightly, apparently due to their foundation. This section is shown in Photograph No. 4.

Section 18. Standard Oil Company. 1910 construction.

Section 19. Standard Oil Company. 1909 construction.

A marked difference was evident in these two sections; and the 1909 section was much superior to the one which was constructed in 1910. There was an excess of binder in the new section, which was sticky and had made necessary the application of stone chips and sand. The older section, whether it had improved under traffic or was originally better, was in excellent condition.

Section 20. United Gas Improvement Company. Road asphalt.

This section, though constructed in 1909, had an excess of binder along the edges of the roadway, and still gave evidence of bleeding. The surface had not suffered from this condition, but was smooth and firm.

Section 21. The Texas Company. Road asphalt.

The material for this section was furnished by a Baltimore contractor, and was similar to that used on section 3. It was evidently too light for the purpose intended, as it was rutted, and the larger stones were exposed and loosened from the road surface.

Section 22. Gulf Refining Company. Asphalt oil "A."

The surface of this section was badly rutted, as in the case of section 2 of the same material. The loosened material, though not held together in any marked degree, was spongy.

Section 23. Warren Brothers Company. Puritan brand No. 17.

This section offers a marked contrast to that which was constructed with Puritan brand No. 10 of the same company. There was but little excess binder, and the surface was as smooth and even as a city asphalt pavement. Photograph No. 5 gives an idea of the character of the surface.

Section 24. United Gas Improvement Company. Road asphalt.

A lighter treatment was given this section than in the case of the previous sections upon which the U. G. I. compounds had been used. The surface was spongy, but the large stones were held firmly in place, and the top was smooth and showed few signs of wear.

Section 25. Impervious Products Company. Fairfield.

It was interesting to note in connection with this section that that portion which was constructed over a dirt sub-grade was

3. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD
Section 16. U. G. I. Antidust.

firm and the stones were held in place, while another portion built on a sand sub-grade was deeply rutted in some parts. There were no signs of bleeding, though the material had pushed out over the shoulders to some extent.

Section 26. Consolidated Gas, Electric Light and Power Company. Tar With a Top Coat of United Gas Improvement Company Compound.

It was found that the tar supplied by the Consolidated Gas, Electric Light and Power Company was too light, so the second material was added as a supplementary coat. The surface was smooth and in excellent condition.

Section 27. Consolidated Gas, Electric Light and Power Company. Tar.

A heavier grade of binder was used on this section, and the result obtained was very good. The surface was spongy to a certain extent, but was not rutted nor marred in any manner.

Section 28. The Texas Company. Texaco Special.

This section was the best of those constructed of The Texas Company material. The surface was smooth and firm; and, though the binder covered the top in such a manner that the individual stones were not visible, yet there was no stickiness nor tendency to flow to the shoulders.

Section 29. Robeson Process Company. Glutrin.

This section is the longest of the entire road. It covers about two miles at the end of the experimental road farthest from the city. Photograph No. 6 indicates the character of the surface. It was hard and smooth, with the individual stones held firmly in place. In fact, some of the stones showed evidence of marked abrasion without any perceptible loosening. The appearance of the edges of the roadway indicated that a small quantity of the material had been washed out from the surface, but no signs of disintegration were noted.

As was stated, the progress of the experiment, together with a lack of complete information as regards sub-grades and features of construction, makes a comparison at this time impracticable. It is interesting to note, however, the behavior of the same material under different traffic conditions, and with different quantities.

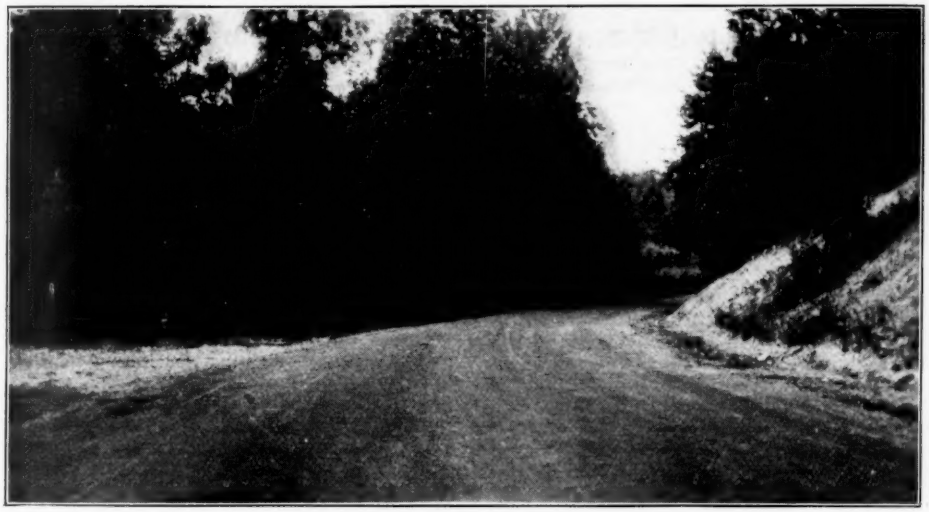
A comparison or comment on the Texas product is unfair, for reasons already given. Further progress of the experiment will serve to indicate the value of the material under the exceptional traffic conditions at the city end and under the ordinary country road use.

4. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 17. Standard Asphalt & Rubber Co., Sarco

The two sections of Impervious Products Company, Fairfield, which were laid in 1909, were similar in appearance, and both showed little signs of wear. Section 4, which was in the heavily-traveled section and which was constructed with 3.67 gallons of binder per square yard, showed a slight excess of binder, and is not in as good condition as section 14, upon which 1.69 gallons of binder was used.

In the case of the United Gas Improvement Company, compound the sections which were constructed in 1909 were better than those which were built in 1910. The best sections were those upon which was used from 2 to 3.5 gallons of binder per square yard.

Warren Brothers' Puritan brand No. 17 was much better than their Puritan brand No. 10. It is true that the first mentioned came under the heavy traffic, while

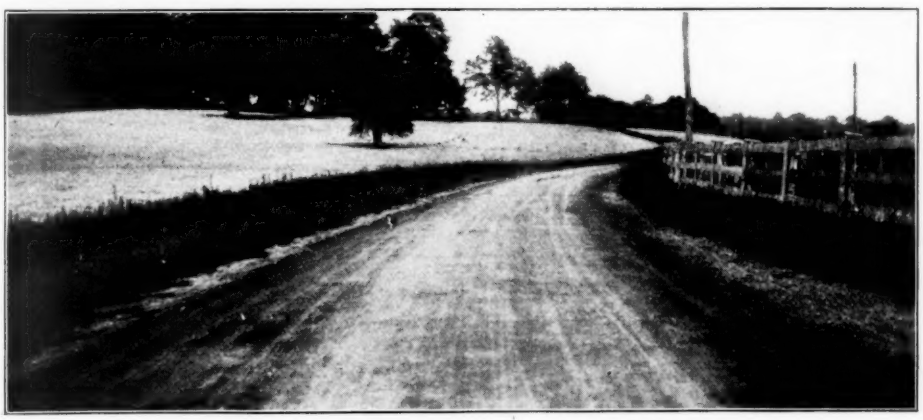


5. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 23. Warren Brothers Puritan No. 17.

the other did not; but, on the other hand, the No. 10 brand was laid on a hill and was subjected to a heavy wash from drainage water, and to extra abrasion due to the grade.

Special mention is due to the three surface treatment materials or antidust compounds; namely, Fairfield Antidust, U. G. I. Antidust and Glutrin. While the experiment is not old enough to develop their lasting qualities to any extent, yet their appearance and condition at the time the inspection was made was of the very best.

The scope of the experiment, the number of materials used, the length of test sections, none of which are less than 400 feet, make it of marked interest. The present mention is merely in the nature of an account of the work. The results developed and the conclusions developed by the Maryland Highway Commission should prove of particular value.



6. PARK HEIGHTS EXPERIMENTAL ROAD, BALTIMORE, MD.
Section 29. Robeson Process Co., Glutrin.

Outline for Standard Sewer Specifications.*

By E. J. Fort and A. J. Provost, Jr., New York City.

SEVERAL meetings of your committee have been held and substantial progress has been made, but its work has not yet advanced to the point where any portion of it can be submitted to the society for adoption.

Your committee realizes that sewer specifications, in order to be worthy of general confidence and adoption as standard, and to insure as general unanimity of opinion as possible as to their various provisions, must cover a wide range of conditions and must be in general harmony with the conclusions of committees of other technical societies and associations which are working upon similar problems.

The members of your committee have also been appointed as officers (chairman, vice chairman and secretary) of the committee of the American Society for Testing Materials, to report upon standard specifications and tests for clay and cement sewer pipes. Such a specification must be a large and important part of any sewer specification and its preparation, in order to satisfy all interests and opinions, those of municipalities, manufacturers and professional men, must be given most careful and extended consideration.

Your committee, in the interests of both societies, is proceeding with deliberation and thoroughness with this portion of its work.

Much valuable information has been collected both in this country and abroad. Extensive series of tests have been carried out, the results of which are available, and arrangements are being made for such other experiments and tests as may be necessary to furnish information that is not obtainable from any other source.

No standard specification for sewer construction which has been generally recognized or adopted as such, has up to the present time been produced and the specifications in use by even the largest and most important municipalities, vary widely in many of their most important provisions. Difference in local conditions would, no doubt, warrant special provisions in regard to some of the more important details, but there would seem to be little reason why, in the most important particulars, standard requirements may not be applicable.

Materials of construction of acceptable quality are usually available.

The functions to be performed by the finished structures are substantially the same, and if the structures are designed to be permanent, as economy and expediency would generally require, the standards of excellence in the materials and workmanship employed, may well be uniform.

Specifications for sewers of extraordinary size and special design, will generally require addenda supplementing the standard specifications to meet the requirements in each particular case, while for pipe and masonry sewers of ordinary size, standard forms should ordinarily suffice.

It is the opinion of your committee that the complete instrument designed to govern every detail in the execution of contracts for sewer construction, should contain:

First—*A Notice to Intending Bidders.*

Such a notice should state clearly:

(a) Time and place at which bids will be received.
(b) Location and extent of the work to be bid for.
(c) Time allowed for the execution of the contract.
(d) Amount of security required.
(e) Manner in which the bid shall be be presented and its contents.
(f) Engineer's estimate of cost.
(g) General cautions in regard to preparation of bid and execution of work.
(h) Other information for the assistance of the contractor in the preparation of his bid.

Second—*Contract or Agreement Proper.*

The contract form should contain in addition to the language of the agreement, bonds, official signatures and acknowledgements of the same, and official designations of the fund from which the expense is to be met.

(a) A certified copy of the official action granting authority to execute such a contract.
(b) A description of the parties to the contract and the officials or employees under whose supervision it is to be executed.
(c) A statement covering in detail all the work to be done and the prices bid for same.
(d) A definition of the authority and duties of the engineer and assistants in control of the work

*A report to the American Society of Municipal Improvements.

as the representatives of the city or party of the first part.

(e) A definition of the rights of the contracting authority in determining the time of commencement, supervision of work, methods of procedure, force to be employed, etc.

(f) A definition of the contractors' obligations in executing the work in accordance with specification requirements and the directions of the supervising authority, and in maintaining the same, in the protection of property from damage, the payment for labor and materials, the completion within contract time, manner and time of payment, liquidated damages for delay beyond the contract time, etc.

(g) Method of procedure in modifying the contract.

(h) Clauses relating to liens, claims, damages, guarantees, assignments, etc.

(i) Enumeration of the provisions of laws and ordinances especially applicable to municipal contract work which must be observed.

(j) Other clauses of special or local application.

Third—*Specifications.*

Following a general description of the work embraced in the contract and the limits within which it is to be done, the limits within which the lines may be located, manner and times of fixing grades by the engineer, the manner in which measurements shall be made, etc., the specifications should include

(A) A DESCRIPTION IN DETAIL OF ALL LABOR PERFORMED BOTH PRELIMINARY AND SUBSEQUENT TO THE EMPLACEMENT OF THE SEWER STRUCTURE, AND THE MANNER OF ITS PERFORMANCE.

(a1) Excavation of Trenches.

1. Dimensions for various sizes of sewers and lengths to be opened at one time.
2. Shoring and bracing.
3. Pumping and bailing.
4. Foundations, their preparation to receive the sewer.
5. Disposition of excavated material.
6. Provisions for the maintenance of street traffic while work is under way.
7. Removal of pavements and disposition of paving material.
8. Protection and support of other structures.

(a2) Refilling of Trenches.

1. Character of material to be used especially about sewer.
2. Manner of placing, ramming, flooding, etc.
3. Disposition of surplus, deficiency, how met.

(a3) Embankment.

1. Dimensions.
2. Character of materials, how placed and compacted.
3. Provisions for traffic through intersecting streets.

(a4) Replacing of Street Surfaces.

1. Unpaved streets. Surface to be restored; maintenance period.
2. Pavements, curbs and sidewalks out of guarantee; how restored; maintenance period.
3. Pavements, etc., under guarantee; how restored.

(B) A DESCRIPTION IN DETAIL OF ALL MATERIALS TO BE EMPLOYED; THEIR QUALITY AS SHOWN BY STANDARD TESTS, AND THEIR PROPER MANIPULATION TO PRODUCE THE FINISHED STRUCTURE.

(b1) Cement and Mortar.

1. Cement, quality, standard tests to be met.
   Cement, how delivered and stored.
   Cement, measurement of volume.
2. Mortar, measurement and proportions of ingredients.
   Method of mixing.
   Character of sand.
   Amount of water.

(b2) Concrete.

1. Size and character of stone or gravel.
2. Size and uniformity of sand grains.
3. Proportions of ingredients to be used in mixture.
4. Methods of mixing, placing and surfacing.
5. Molds and forms.

(b3) Brick Masonry.

1. Quality and size of bricks to be used.
2. Manner in which they are to be laid and protected from injury. (Inverts, arches, haunch walls, manholes and catch basins, spurs and branches.)

(b4) Stone Masonry.

1. Quality and dimensions of stones. Rubble, ashlar and dry masonry, coping stones, basin heads, etc.
2. How laid to produce finished walls and structures.

(b5) Steel and Iron.

1. Rods for reinforcement, quality, dimensions and tests.
2. Structural shapes, quality, dimensions and tests.
3. Expanded metal, wire mesh, etc.
4. How placed in the finished structure.
5. Spikes used in platforms, grill-

ages, cribs, etc., quality, dimensions, etc.
6. Cast iron.
Quality and tests.
Conformity to place.

(b6) Sewer Pipe.
Specification for pipe sewers and sewer pipe is to be in accordance with recommendations of Committee C4 of the American Society for Testing Materials, appointed to report upon "Standard Specifications and Tests for Clay and Cement Sewer Pipe." The work of that committee is not yet completed. Its last annual report, June, 1911, is referred to.

(b7) Pile and Timber Foundations.
1. Bearing Piles.
a. Kinds and quality of timber.
b. Dimensions.
c. How driven.
d. How measured and paid for.
2. Foundation timber.
a. Kinds and quality of timber.
b. Dimensions as shown on plan.
c. How laid and secured.
3. Sheathing and Bracing Timber.
Manner of Placing.
a. To remain in the work.
Kind, quality, dimensions, etc.
b. To be withdrawn.
Kind, quality, dimensions, etc.

(b8) Sewer Connections.
1. Manner and time of connecting house drains.
2. Connections intersected to be reconnected.
3. Flow of old sewer—how cared for.
4. Method of making all connections.

(b9) House Connection Drains.
1. Spur pipe to receive house connection drains. Spacing and size. How laid.
2. Stand pipes on deep sewers.
3. Cast iron pipe for house connection drains, where necessary, how laid, quality, etc.

(b10). Manholes.
1. Concrete, brick.
How built, dimensions, etc.
2. Manhole heads and covers.
Standard plan.
Weights, dimensions, etc.
Quality of iron.
Inspection.

(b11) Sewer Basins or Inlets.
1. Standard plan.
2. Excavation, dimensions, how made.
3. Heads and gratings or pans.
4. Traps.
5. Culverts, dimensions, how laid and connected to same, etc.
6. Restoration of curb, sidewalk and pavement after construction.

Discussion is invited upon the above outline of the subject matter to be incorporated in the finished specification, and suggestions and criticisms will be welcomed.

Bituminous Macadam Construction.*

By A. N. Johnson, State Engineer Illinois State Highway Commission.

OBSERVATION of macadam roads built with a bituminous binder seems to point to the success of this form of construction on many miles of road, and it is with this construction that the present paper will deal, without an attempt to discuss further the relative merits of this construction with other classes of pavement.

There are many features to be considered in the construction of bituminous macadam which the limited scope of this paper will necessitate passing over with but slight mention. As with any ordinary macadam construction, it is of prime importance that the roadbed be properly prepared both as to drainage and compactness; yet, fundamental as are these requirements and as supposedly well understood, no small number of the failure seen today can be attributed to lack of attention to these important features of the construction. If the roadbed has been properly drained and compacted, there will not be required a greater thickness of completed pavement than seven to eight inches. The material should be put on in two layers, the first layer forming the base on which the wearing layer is to be placed.

The method of placing the base usually does not vary, whatever may be the type of construction used for the top layer. It is essential that this base layer be compact and true to shape, and this cannot be accomplished unless the stone is well spread, thoroughly harrowed and rolled, and then well bonded with stone dust or gravel in the same manner and with as much thoroughness as though the road were to be left with an ordinary water-bound surface.

*Paper before the Indiana Engineering Society.

The size of the pieces of stone in the different layers is a matter for some consideration. It has been the practice of the Illinois Highway Commission to use stone varying from one inch to two and one-half inches in size. As practically all of the stone available for road work in Illinois is limestone, there is required a somewhat larger sized material for surface work than is demanded with a harder variety of stone. Also, it has been found convenient to use but one size of stone in both layers of the road, so that the screens at the state crushers are provided with one-inch holes and two and one-half-inch holes, and no intermediate size. A dust screen with three-eighths-inch holes is used to prepare stone chips from the one-inch material.

The depth to which the stone is to be spread for the base depends upon the thickness the base is to be after it has been rolled. If the total thickness of the pavement is to be eight inches, the wearing surface is not usually made less than two and one-half inches in thickness, leaving five and one-half inches for the thickness of the lower course. If the material for the top course is composed of two and one-half-inch sized pieces, it is recommended that this layer be made three inches thick, leaving five inches for the thickness of the base. A layer of stone about six inches thick, measured loose, will roll to five inches, possibly a little less, depending somewhat upon the nature of the material.

After the stone has been spread to the required thickness, which should be done with great care so that there will not be more in one spot than in another, it should also be thoroughly harrowed with a coarse-tooth harrow. The effect of this is to shake the various sized pieces of stone into place, and, as is well known, a box of loose stone can be compacted no better than by shaking them; so, too, we find that the loose stone in the road is compacted by shaking or harrowing, which allows the smaller pieces to take their natural position at the bottom of the layer and the larger near the top. It will be found, moreover, that harrowing the material in this way will permit the roller to compact the material without the creeping that is often observed, and with one-half as much rolling.

The lower course should not be covered with screenings until it has been thoroughly compacted and each piece of rock keyed tightly in place so that when a wagon load of screenings is driven upon it the wheels will disturb the rolled stone scarcely any, if at all, and leave no decided rut or track. The screenings should be spread evenly over the whole surface and slightly watered. If the foundation is clay and wet weather has prevailed, the greatest care must be taken in watering the screenings of the first course before the road is tightened, otherwise the surplus water will soften the foundation, which must be dry before further progress can be made. After the screenings have been slightly washed or worked into the stone more should be spread and again watered and then rolled to tighten the surface, more water and screenings being added until the surface of the base, or lower layer, is water-tight. Screenings should not be applied so as to separate the pieces of rock which have been already keyed, but merely to fill the voids in the compacted stone with as little disturbance as possible.

The amount of crown that the finished road is to have will decide the amount of crown that the earth roadbed and the base should have. Space will not be taken here to present the various arguments for a greater or less amount of crown. In general, the observation of the writer is that one-half-inch per foot is not enough for the average country road with a bituminous macadam top, nor is it practical to exceed three-quarters of an inch per foot. On roads to sixteen feet in width, not less than three-quarters inch per foot is advisable. On roads twenty feet in width or wider, indicating that there is a large amount of traffic spread more or less evenly over the whole road, the crown can be somewhat less than on the narrower roads, but it should never be less than one-half inch. On the wider roads a good practice is to increase the crown somewhat towards the gutter, perhaps starting on three-quarters of an inch and gradually flattening towards the center, which would be effected by a curved cross-section.

On narrow roads twelve to fifteen feet in width it is necessary to give special attention to consolidating at least three or four feet of the earth shoulder on either side of the road to hold the stone in place. As can readily be appreciated, when the roller is near the center of the road, there is a tendency to push the stone sidewise, and if there is nothing to resist this movement the stone becomes more and more open as the roller proceeds and the pieces of rock do not tighten. On wider roads there is not so much difficulty from this cause, as a small amount of rolling towards the edge of the stone at first will place it sufficiently solid to resist any further movement of the stone at the center, for which reason it is very much easier to get a well-shaped, well-compacted road that is eighteen feet or wider, than one but twelve feet wide. We now come to a discussion of the bituminous surface proper.

There are various methods of construc-

tion employed for bituminous macadam surfaces. They are usually divided into two general classes, one where the material is mixed with the binder before being applied to the road, called the "mixing method," the other by which the rock is first placed upon the road and the binder poured into it, usually called the "penetration methods." By far the largest amount of work undertaken by highway engineers on country roads is by the penetration method, for the simple reason that it is very much cheaper and more practical for the conditions usually existing in country road work. This method alone will be discussed in detail. Moreover, it is the conviction of the writer that with the binders ordinarily employed for this work and for the traffic conditions usually prevailing on the majority of country roads, the best results will be possible with good construction by the penetration method.

As is well known, the stability or strength of a macadam road surface to resist the action of traffic depends entirely on the mechanical locking together of the pieces of stone making up the road surface, and until this is accomplished the road surface has no cohesion. The more perfect this keying or locking together of the pieces of the stone, the more rigidity, therefore the object of any binder, whether of stone dust or of bituminous character, is to hold the pieces of stone firmly in position after they have become well keyed and locked together. In many pieces of road that have been constructed, and in some forms of construction that have been proposed, this essential principle of the macadam construction seems to have been ignored; as, for example, in the type of road employing some form of bituminous binder in which the pieces of stone of the wearing surface do not come in contact at all, but are held apart by the bituminous material, which here acts as a matrix, forming in reality a bituminous concrete similar to ordinary concrete, in which the matrix of cement mortar is replaced with a matrix of bituminous material. If, therefore, the matrix is not in itself sufficiently strong and rigid to withstand the pressure of traffic, such a road is doomed to failure, particularly if submitted to the traffic conditions on most country roads where the traffic tends to keep to a more or less narrow strip of the road, bringing undue pressure thereon. The fact that some of the roads built with a bituminous matrix have proven fairly satisfactory is chiefly because the traffic conditions, under which they are used, so rolls and works the road that one portion receives about as much pressure as another, and if there is a slight tendency to give at one time at one point subsequent traffic will tend to roll out the unevenness that has been formed. Roads of this character that have come under the writer's observation, although giving fair satisfaction with the conditions under which they are used, would last but a short time under country road traffic. Thus it would appear that if bituminous macadam is to be successful it is necessary in its construction to follow what has been learned by long experience, and that is to have the macadam itself firmly locked and keyed together and the stability of the road thereby assured before any binder has been applied.

The next step, therefore, after the base course has been prepared, as has already been described, is to spread the stone for the wearing layer. The stone for this layer, if limestone, should be composed of pieces two and one-half inches in size and graded from this downward. If a three-inch layer is to be made when consolidated, which is as thick as this layer need be, the stone should be spread to a thickness of three and one-half inches and thoroughly raked or harrowed so as to bring the larger pieces to the surface in order that the surface may be composed in the first instance of as nearly uniform sized material and to give as great compactness as possible after it is rolled. As soon as spread uniformly and harrowed, the surface is to be rolled until it is thoroughly tightened. It may be found that there will be places where the stones do not lock together firmly; on such places a small amount of stone should be spread, just sufficient to fill the interstices, and then rolled. The effect of this rolling is to force the pieces of stone into the interstices, thus keying the whole surface until tight. It is important that great care be taken in rolling this upper layer that it be thoroughly tightened. When this has been accomplished there will still remain interstices of appreciable size which should be filled with stone chips. These chips should be perferably of some harder material than limestone, and it is often possible to secure screened gravel that will prove excellent for this purpose. The size of the chips should vary from one inch to three-eighths of an inch, and they should be spread over the surface of the upper course- just sufficient to fill the inter stices.

A good method to insure this being done is first to shovel the chips on by hand, throwing each shovelful so as to cover as much area as possible; then follow with hand brooms, sweeping ahead the surplus pieces and allowing all the interstices to become thoroughly filled. When this is done the road is ready for the bituminous binder, as no rolling should be attempted after the chips have

been spread and before the binder is applied. If the chips are rolled before the binder is applied the effect would be merely to allow them to set in between the stones which have already been keyed and tend to loosen the surface rather than tighten it, so it is important that after the surface has been thoroughly keyed and the chips spread, no rolling be done until after the bituminous binder has been applied.

There are various methods of applying the bituminous binder. One method is to turn the heated binder into cans, thence pouring it on the roads, and many roads have been built in this manner. There is to be seen in almost all work of this character, unless an exceptionally skillful man is employed to do the spreading, places in the road where the binder has been applied thicker in one place than another, and the joints where one sweep of the can is followed by another can usually be seen. This unevenness is generally much more pronounced after the road has been in service than immediately after construction, so that evenness in the distribution of the binder is found to be a most important detail. Binders have been spread by machines having a number of nozzles or openings side by side, which are moved over the surface of the road, the binder being thus distributed in a layer a number of feet wide at a time. In some of these machines the binder flows from the nozzles merely by its own weight, generally termed gravity machines, while with others pressure is applied. Binders have also been applied through a single nozzle at the end of a hose.

Experience seems to show the importance of the following conditions being observed: The binder must be spread uniformly, that no more binder be used than is necessary to cover the surfaces of the stone and the chips. To get these results it is necessary that the binder be put on, as nearly as possible, in the form of a spray; and, owing to the fact that it is practically impossible to get a thoroughly uniform surface condition before the binder is applied, it may be necessary to apply slightly more binder at some point in the surface than another, so the writer has found in his work the best results have been obtained by applying the binder through a single nozzle of such a form that the binder is thoroughly atomized and is delivered to the road in the form of a finely divided spray. With this method of application there has been found no difficulty whatever to get the binder on as uniformly as is required and at the same time to have sufficient control to give those spots on the road that may need it the special attention they require.

The device that has been in use on the work of the Illinois Highway Commission consists of a tank wagon, holding about five hundred gallons, supplied with a fire chamber. The tank, which is cylindrical, is sufficiently strong to withstand a pressure of sixty to eighty pounds if found needful. The tank wagon is fastened behind a roller or tractor, to which is attached a Westinghouse air pump with a metal hose leading from the air pump to the distributing tank, on which is a gauge so that the pressure may be controlled by the operator of the tractor. Leading from the tank wagon is a metal hose which ends in a nozzle made of a two-inch iron pipe with a right-angle bend, in the end of which a plug is screwed, having an opening about one-half inch in size; on the inside is a small cone, so that by screwing the plug or less tight the size of the orifice can be regulated.

Leading into the two-inch pipe forming the nozzle there is introduced a one-half-inch steam pipe which is connected back to the boiler of the tractor. The steam pipe extends within the nozzle to just above the orifice. When in operation the pressure is applied to the wagon, thus forcing out the bituminous binder. The steam is turned into the nozzle as the binder issues, which tends to spray and break the bitumen into very fine particles, the effect being a sort of mist which can be very nicely regulated so that any given amount of material from a mere wash to any quantity desired, can be applied.

It is important that all hose connections for this work be of metallic type, as lighter hose or hose of any other material will soon become rotted or burned by high temperature necessary for most of the bituminous compounds used.

Also, the complete outfit includes an extra heating tank of the same capacity as the distributing wagon, which, as soon as empty, may be readily filled from the auxiliary tank. To do this the air pump is reversed, creating a partial vacuum in the distributing wagon and the binder is sucked back through the distributing hose which is inserted into the auxiliary wagon. With one auxiliary kettle and one distributing wagon, each of five hundred gallons capacity, fifteen hundred to two thousand gallons per day can be applied. Additional auxiliary heating kettles would increase the output. Working continuously, a maximum of five hundred gallons per hour can be applied. On most jobs, however, where but one roller is available, fifteen hundred to two thousand gallons per day will be about as fast progress as can be handled efficiently.

The binder issuing under pressure and carried by the force of the steam will

fill all the interstices and cover the sides of the rock and the chips with a thin layer. Enough of the binder should be applied as to leave none of the surfaces of the stone that are visible uncovered. Care should also be taken that the binder strikes the surface perpendicularly, otherwise if applied in a slanting position or if the nozzle is moved too rapidly across the road it will be found that one side of the stones will be covered with the binder while the other side will have but little. The amount of binder to be applied should be as little as is necessary to secure a thorough coating for all the exposed surfaces of the stone. This usually requires from three-quarters of a gallon to one gallon per square yard. When this treatment has been applied the surface should again be treated with the stone chips so as to make practically one layer of the chips evenly distributed over the entire surface of the road. These chips had better be applied as soon as possible after the binder has been spread, if practicable, following immediately behind the spreader. They may be spread somewhat in excess and swept ahead with a broom. It is important that the chips be clean and have as little dust adhering to them as possible. One advantage noticed with the steam jet in connection with the operation of this apparatus is that the force of the steam seems to blow the dust from the surface of the stone and thereby insures a cleaner surface for the binder.

After the chips have been spread the second time more binder is applied, which should be sufficient thoroughly to cover all of the chips. This usually requires one-half to three-quarters of a gallon per square yard. Coarse sand, if available, should then be spread upon the road, or finely screened gravel may be used; if neither are available, then the stone chips. There is no objection to the stone chips if the stone from which the chips are made is a hard variety of rock, but it is better to use some other kind of chips than from limestone. After the surface has been sanded or chipped just sufficient to prevent the wheels of the roller from sticking, the road should be rolled. The roller should be provided with pipes with small orifices an inch or two apart so as to keep the wheels of the roller wet while rolling. If this is done there will be no difficulty whatever with the binder sticking to the roller wheels. The rolling should continue until the surface is seen to be well set and compacted. It will then perhaps be found that there are some spots needing further treatment to bring them to a uniform appearance with the remainder of the road, in which case, if there be any dust, it should be swept away, a few chips, binder and sand applied and the whole rolled to give a uniform surface. It is probable that quite as good or better results can be obtained, after the road has been sanded and rolled, to throw it open and let the traffic develop any places in the road that need further attention.

This form of construction, it will be seen, gives a road which has the strength and rigidity of the ordinary macadam, with a water-tight covering of bituminous compound holding the surface of the road intact against the action of motor traffic or dislodgement by the mud that adheres to the wagon wheels. So long as the waterproof covering can be maintained the road should be in perfect condition, and therefore the only maintenance required in this construction is to keep this bituminous covering intact. The chips or sand, whichever may be used, with which the covering is mixed, furnishes the resistance to abrasion. This is greatly helped by the binder, if of proper quality, which will tend to keep the particles covered or imbedded as fast as they may become loosened or broken by the traffic. When in the course of time the surface has become sufficiently worn to expose the stone making up the wearing course, it can be renewed by thoroughly cleaning the road, putting on a light application of the binder and renewing the chips or sand. From present observation there is every indication that such a form of maintenance will be possible at a comparatively small expense and furnish, in the meantime, a character of road surface that is well adapted, as any so far devised, to the ordinary traffic conditions on our main highways at present.

It is evident in this form of construction that the character of the bituminous binder plays no small part and that to be successful the binder must have sufficient stability in hot weather that it will not be easily pressed or displaced and cause an uneven road surface; nor at the same time must it become so brittle or hard in winter that it will be broken by the traffic and dislodged by the wind or other forces. To say that such a binder has been found would mean that most of the difficulties in this form of construction had been solved. Some binders have certain qualities that give good results under certain conditions and poor under others. Some binders more nearly meet the requirements than others, but there has not been sufficient time elapsed with this form of construction and in the use of these different binders to state definitely what, in the long run, will prove to be the best. While we might draw a conclusion as to which binder was best, further experience might show that some other binder, with somewhat different properties, would have greater durability.

There are two general classes of bituminous binders—those produced from the coal tars and those produced from asphaltic oils and natural asphalt, one being a coal-tar bitumen and the other asphaltic. Much study has been devoted to both the chemical and physical properties of the various coal tars and coal-tar compounds and the result of the various compounds in road construction observed, to the end that definite specifications could be drawn from which the compounds should be manufactured. The same is also true of the asphaltic binders. While the variety of compounds of a bituminous nature on the market today is equalled only by the variety of breakfast foods, there is, however, one very encouraging fact, and that is there are very few of the binders that have come under the writers observation that are absolute failures, while with the majority very good results have been obtained. He has found, however, that it is absolutely essential, if any knowledge whatever is to be had concerning the character of the bitumen used, that it be brought under some definite specification and that it be tested before being applied to the road; that trade names are no criterion as to the composition and characteristics of a given compound. Doubtless the manufacturers of these compounds can in a measure justify or excuse the variability of their products by the fact that they are called upon to fulfill so many various specifications that they might well argue if engineers and road builders are so divided in their opinion as to what is desired and wanted, surely little or no harm could result by furnishing binders of various characteristics, waiting, before standardizing their output, until the chemists and engineers are more nearly in accord as to what should be used. However, the latitude that manufacturers allow themselves in many of these cases is rather greater than most engineers and chemists, who have given the subject careful study, usually desire, and therefore the recommendation is here made that the binders be bought under specification and be tested to see that the qualities desired have been secured. There is very little or no difficulty to manufacture binders to meet any reasonable specilcation.

For coal tars the following specification has been used by the Illinois Highway Commission:

Specific gravity at 25 degrees C. shall not be over 1.24.

Free carbon shall not be over 20 per cent. by weight.

The consistency as determined by the Howard & Morse float apparatus at 50 degrees C. should be between 2½ mins. and 3 mins.

The fractional distillation shall result as follows:

To 110 degrees C. not to exceed 2 per cent., with no ammoniacal water.

From 110 degrees C to 170 degrees C. not to exceed 5 per cent. distillate, of which not more than ¼ shall be naphthalene when cold.

From 170 degrees C. to 270 degree C. not to exceed 30 per cent. nor less than 20 per cent., of which not over one-third shall be solids when cold.

Over 270 degrees C. not less than 50 per cent. by volume of pitch residue to be obtained, which shall be sticky and not greasy or granular in appearance.

When a cylindrical prism of tar 1 centimeter in diameter is maintained at a temperature of 0 degree C. it shall bend into a semi-circle of 2 centimeters in diameter without checking.

For asphalt binders the following specifications are now in use:

The asphalt shall have a specific gravity not less than 0.97 at 25 degrees C.

The asphalt shall be soluble in cold carbon bisulphide to the extent of at least 98 per cent.

Of the total bitumen not less than 20 per cent. nor more than 25 per cent. shall be insoluble in 86 degrees B. naphtha.

When 20 grams (in a tin dish 2½ inches in diameter, with vertical sides) are maintained at a temperature of 170 degrees C. for 5 hours in a N. Y. testing laboratory oven, the evaporation loss shall not exceed 2 per cent. and the penetration shall not have been decreased more than 25 per cent.

The fixed carbon shall not exceed 12 per cent. by weight.

The penetration as determined with the Dow machine, using a No. 2 needle, 100 gm. weight, 5 sec. time and a temperature of 25 degrees C., shall not be less than 5.0 mm. nor more than 10.0 mm.

The asphalt shall not contain to exceed 2 per cent. by weight of paraffine.

For details as to methods of analysis of bituminous compounds the reader is referred to Bulletin No. 38 of the U. S. Office of Public Roads.

The question as to whether tar or asphalt compounds give better results is one on which the writer can not at present express an opinion, merely because the experience so far had with these different compounds has not proven sufficiently conclusive to warrant any definite conclusion. Both good results and poor results have been obtained with each of these bituminous materials.

Some engineers are of the opinion that under certain traffic conditions better results are obtained with one class of materials than another; for instance, with a preponderance of motor traffic, the opinion seems to be in favor of asphaltic com-

pounds, and with a preponderance of steel tire traffic, that the tar compounds prove the better. However, these conclusions, as far as they have come under the writers observation, seem to have been drawn chiefly from merely surface treatment of old roads. Nothing that he has observed would seem to indicate that a similar distinction could be made from roads constructed as has been described.

The specifications for bituminous material for the form of construction herein outlined are presented, not so much as being necessarily a criterion, but as a suggestion and guide to those who desire to purchase these materials and use them and who may not have given the subject very extended inquiry. It is entirely possible—in fact, quite probable—that these specifications will be changed and other requirements found necessary as more experience has been gained from the work already done. In general, it has been the plan in the past year or two in the use of these binders, on the work under the supervision of the Illinois Highway Commission, to use on each stretch of road at least two binders and so to distribute them on different jobs so that each will be placed in juxtaposition with some other. Thus, with a chance to compare each binder with a large number of other binders, and by observation of each binder under various conditions, it is hoped that reasonably exact conclusions as to their fitness for use in this form of construction may be formed.

The Youngstown Slag Road.

Editorial Correspondence.

IN connection with a series of experiments along the line of dust prevention and road preservation by the U. S. Office of Public Roads, a slag road was constructed in Youngstown, Ohio, in the summer of 1909. This experimental section, while not the first slag road, possesses features of construction which are unique and which indicate the value of this material as road metal.

The road chosen is known as Belle Vista Avenue and is a main travelled thoroughfare 2,754 feet in length, terminating in macadamized main roads at either end. The material was furnished by the Carnegie Steel Co., and was laid under the direction of an engineer from their office and Randolph Martin, an engineer from the U. S. Office of Public Roads. The county graded and prepared the sub-grade, and furnished a ten-ton steam roller for the work. The steel company furnished all material including the blast furnace slag and binding materials and performed work incident to laying and finishing the road.

The first 1,500 feet of the road was constructed in two courses, the bottom course consisting of a six inch rolled layer of screened slag ranging in size from three and one-half inches to one and one-half inches; and the top course consisting of screened slag ranging from two inches to three-eighths inch in size and rolled to four inches at the center and one inch at the edges. This first division is divided into three sections of 500 feet each which were constructed as follows:

Section 1. The surface of this section was bonded with blast furnace slag screenings, three-eighths inch to dust, in the usual manner.

Section 2. The surface of this section was bonded with blast furnace slag screenings, three-eighths inch to dust, which had been previously mixed with five per cent of its own weight of powdered quick lime.

Section 3. The surface of this section was bonded with slag screenings as as described for section 1, with the exception that a solution of concentrated waste sulphite liquor was used to puddle the surface instead of water. One gallon of sulphite per square yard was used.

Section 4. This section consists of 300 feet of roadway adjoining section 3, and was constructed in the following manner: The foundation course was laid in the same manner as sections 1, 2, and 3, and was rolled until absolutely firm. A three-inch compacted course of tarred slag was placed upon the foundation course. The mixture of tar and slag being approximately as follows: To every fifteen cubic feet of slag running from two inches to dust about six gallons of hot tar was added and mixed by hand until the slag particles were completely coated. Unless the slag was warm and dry it was required to heat it before mixing. While still warm this mixture was applied and rolled. A light coating of hot tar was then painted upon the rolled surface and sufficient screenings were applied to fill the surface voids and take up all surplus tar, this surface being again rolled.

Section 5. The second division is 300 feet in length and is known as section 5. It consists of a single course of screened slag ranging from three and one-half inches to three eighths inch, rolled to a thickness of eight inches at the center and five inches at the edges, and bonded with slag screenings.

The third division consisted of two sections laid in two courses. The bottom course consists of a seven inch layer of rolled unscreened slag, and the top course consists of a layer of three and one-half inches to three-eighths-inch broken slag rolled to five inches at the center and two and one-half inches at the edges. Section 6 was bonded with blast furnace slag screenings three-eighths-inch to dust. Section 7 was constructed in the same manner as section 6 with the exception that open hearth slag screenings three-eighths-inch to dust was used as a binder.

The experimental road was officially inspected by representatives from the U. S. Office of Public Roads during January, 1911, eighteen months after construction. The weather at the time of this inspection was rainy and during the previous months there had been a succession of frosts and thaws. The following is the comment noted on the road:

Blast-furnace Slag.—When inspected just after a thaw the first section showed to advantage in comparison with the fifth and sixth. The surface, while not as firmly bound as some of the sections in which a binder other than blast-furnace slag screenings had been used, was in excellent condition. In experiments Nos. 5 and 6 the center of the roadway had been quite badly raveled by horses' hoofs, but little difference between the two sections of road was to be noticed, except that in experiment No. 5 a rather soft spot had developed in the center of the road at the middle of the section.

Blast-Furnace Slag—Open Hearth Slag Screenings.—The section, (section 7), treated in this experiment was at the time of inspection undoubtedly superior to any of the others, with the exception of the tar slag section. The surface was very firmly bonded and could not be dug into with a knife, except in a number of small spots from two to four inches in diameter, where the surface was soft and powdery. These spots were scattered irregularly over the road to the extent of seven or eight to each 100 linear feet and were evidently caused by the presence of a few soft, crumbly fragments of blast-furnace slag. With this exception the entire surface appeared almost as solid as Portland cement-concrete. On one side of this section, about 50 feet from the the northern end, the earth shoulder had settled and sloughed away for a distance of about 35 feet, and the edge of the road at this place had been cut back by traffic for a distance of six inches. The trouble can undoubtedly be attributed to a fresh fill, which was not consolidated sufficiently before the road was constructed. This place is to be repaired by building a crushed slag shoulder.

Blast-Furnace Slag Screenings and Lime. The section treated in this experiment was somewhat raveled and scarcely better than those described under sections Nos. 5 and 6. During construction it seemed that this section would prove more satisfactory than any of those bound with plain blast-furnace slag screenings and during the past summer it actually proved somewhat more satisfactory. The open winter, however, showed section No. 1 up to better advantage.

Blast-furnace Slag and Waste Sulphite Liquor Preparation.—The section treated in this experiment was in good condition and showed a fairly well bonded surface. This section was in slightly better condition than that described under experiment No. 1, but it was not as well bonded as the section described under experiment No. 7.

Blast-Furnace Slag and Refined Coke-Oven Tar.—Section 4 showed up to better advantage than any of the others at time of inspection. The surface was perfectly bonded and presented a rather mosaic appearance. Although the road at this point had been constructed on a fresh fill which had settled somewhat since, the tar slag surface showed no evidence of having cracked when adjusting itself to this settlement.

An inspection by a representative of MUNICIPAL ENGINEERING, made on July 27, 1911, about two years after the construction of the road, showed that the results indicated in the previous inspection have become more marked during the additional six months wear. The road surface was dry and dusty in parts, due to a continued period of dry weather.

Of the three experimental divisions constructed of blast-furnace slag, the first, section 1, was by far the best. This is the section constructed of two courses of screened blast-furnace slag with a slag binder. It showed some signs of rutting, though the ruts were not of sufficient size to be objectionable. The surface was dusty to a slight degree.

The second experimental division, section 5, was constructed in one course of screened blast-furnace slag. This section is badly rutted and the surface has raveled to a marked degree. A very noticeable hollow filled with loose particles of slag had formed at the junction of this section with the preceding tar and slag section.

The third experimental division, section 6, was constructed of a course of rolled

screened blast-furnace slag laid on an unscreened base, and with a binder of the same material. This section, while better than section 6, is not nearly so good as section 1. The traveled portion has been left practically bare of binder and a heavy dust has formed at either side, indicating that raveling is likely to result.

Section 7 was constructed after the same manner as section 6, except for the fact that open hearth slag was used. It is far superior to section 6, the surface being hard and smooth and less dusty than any of the sections, with the possible exception of that constructed with tar and blast-furnace slag.

Section 2, constructed of two courses of blast-furnace slag, the top course being bonded with a mixture of slag screenings and dust and five per cent of powdered quick lime, was not in as good condition as section 1, which had only the slag binder. It had rutted more than section 1, and the larger particles of the top course were left exposed.

Section 3, which was constructed in two courses and on which waste sulphite liquor was used instead of water, is superior to the section in which lime was used in the binder, but is not so well preserved as the slag binder section. It seemed, however, to be a little less dusty than either of the two preceding sections.

Section 4 is the best division of the road. It was constructed in two courses, with a tar binder in the top course as noted previously. It extends across a bridge located between and on the lower portions of two hills, so is subjected to the additional wear incident both to the high speed of descent and extra friction of ascent of vehicular traffic; as well as possible erosion of water, which, owing to side embankments, must at times overflow the side ditches and cover the road. The surface is hard and dustless and resembles a much worn asphalt street in appearance. The larger particles of slag are exposed in spots, but are held firmly in place by the tar binder. The binding material, a crude coke-oven tar, seems to possess valuable properties for use in this connection, superior by far to most crude tars which have come to the writer's attention. The following is an analysis of the material made for the Carnegie Steel Co., by the U. S. Office of Good Roads, A. L. Cushman, director Division of Tests:

Specific Gravity 25° C.....	1.187
Results of Distillation:	
Ammoniacal water, by volume	1.0 %
First light oils to 110° C. by volume	1.0 %
Second light oils, 110°-170° C. by volume	6.0 %
Dead oils, 170°-200° C., by volume	9.2 %
Dead oils, 200°-270° C., by volume	23.6 %
Pitch residue by difference....	59.2 %
	100.0 %
Pitch residue by weight.....	64.70
Material insoluble in cold carbon bisulphide (free carbon).....	8.56 %

Remarks: This is a crude coke-oven tar containing a considerable amount of napthalene. The second light oils and dead oils to 200° solidified when cold and the dead oils from 200° to 270° C. contained about one-half their volume precipitated solids when cold. The pitch residue was brittle and showed a fairly lustrous fracture.

To produce a material at all suitable for road construction from this tar, at least 17 per cent. should be distilled off. This will give a viscous residue showing the following characteristics:

Specific Gravity 25°.....	1.225
Melting point (cube method in water)	30° C.
Penetration No. 2 needle, 5 seconds, 50 grams, 5° C.....	47
Distillate to 270° C, by volume	28.4%
Pitch residue.....	71.6%
	100.0%

A still better product could be obtained by distilling the crude tar until 40 per cent. had been removed and then diluting the residual pitch with dead oils from which the crystallizable napthalene had been separated, until it showed a melting point of approximately that given above.

The use of slag, as set forth in this experimental road, indicates that the material possesses value as a cheap road metal, in a community situated near a large steel mill. Laid after the manner of a limestone macadam road, the blast furnace slag road at Youngstown does not possess the durability, even in the best portion, of the section with the slag binder; and those sections laid with lime and sulphite liquor seem inferior to that in which the slag binder is used, though there is little difference between them.

The open-hearth slag section approaches more nearly to the limestone macadam road of the same age; and it is probable that with a more uniform hardness of material the small holes caused by soft particles might be eliminated. The cementing quality of the open hearth slag seems to be excellent.

As used with a tar binder, an excellent road is obtained with the blast-furnace slag and it is probable that the Youngstown tar slag road will prove very nearly as durable as a similar road in which limestone is used.

A comparison of slag with various materials used in road construction is given herewith. The tests as recorded are the standard tests for hardness, toughness, cementing value, etc., and the weight refers to the solid material.

The fact that the slag dust is heavier than the ordinary trap rock or limestone macadam dust is a factor which should add to the durability of the road, owing to this fact that the binder is not so easily drawn from the surface and blown from the road. It was noted that an automobile traveling at the rate of about twenty miles an hour along the intersecting macadam road on Mahoning Avenue, raised a cloud of dust which arose to a height of about fifteen feet and was blown along the road for a considerable distance. Upon coming onto the blast-furnace slag section with the slag binder, the dust arose only to a height of about four feet and the wind, which was blowing at right angles to the line did not carry it off of the road.

MAXIMUM AND MINIMUM RESULTS ON ROCK AND SLAG SAMPLES, UNITED STATES DEPARTMENT OF AGRICULTURE—OFFICE OF PUBLIC ROADS.

		Dolomite	Granite	Gravel	Limestone	Sandstone	Shale	Slag	Slate
No. of Samples		105	122	85	489	193	9	33	42
Specific Gravity		2.75	2.60	.....	2.70	2.55	2.65	2.80	2.75
Weight, lbs. per cu. ft		172	162	.....	168	159	165	175	172
Water absorbed Lbs per cu. ft.	max.	6.91	2.77	.....	13.22	11.60	4.84	4.40	2.10
	min.	0.07	0.04	.....	0.03	0.02	0.50	0.04	0.05
Per Cent of Wear	max.	18.6	24.6	.....	34.2	41.7	16.2	13.5	6 9
	min.	2.1	1.1	.....	1.8	1.0	3.2	2.7	1.6
French Co-efficient of Wear	max.	19.2	37.0	.....	21.7	40.8	12.6	14.6	24.4
	min.	2.2	1.6	.....	1.2	1.0	2.5	3.0	5.8
Hardness	max.	18.3	19.2	.....	19.1	19.5	17.7	18.0	19.7
	min.	4.4	13.6	.....	0.0	0.0	13.9	10.7	1.1
Toughness	max.	27	31	.....	25	60	12	21	40
	min.	4	2	.....	2	2	3	3	1
Cementing Values	max.	179	255	500	500	500	367	463	500
	min.	9	3	3	10	3	28	1	1

Refuse Disposal in Cambridge, Mass.

LAST SPRING a committee was appointed by the city council of Cambridge, Mass., which spent about two months in the study of the problems of the city streets, devoting their attention particularly to street paving, the maintenance of pavements, and the collection and disposal of refuse and wastes, not including garbage. This committee consisted of George M. Clukas, representing the city at large; Lewis M. Hastings, city engineer; Edward W. Quinn, superintendent of streets, and Harrison P. Eddy, representing the Cambridge taxpayers' association.

The report of the committee has recently been published, and the portion concerning the collection and disposal of refuse is reproduced in the following pages, as an indication of the ordinary result of such brief investigations. It would seem that only the most obvious modifications of existing processes had been presented, and considering the large problems assigned and the short time allowed, it is not surprising that an exhaustive study could not be made. The report is valuable, nevertheless, and its recommendations, if followed, will result in sanitary improvement and efficient service.

Committee Report.

Our attention has been called by the city officials to the increasing difficulties of finding suitable dumping places for the refuse collected by the city departments, and the increasing cost of such collection. We have, therefore, given much consideration to this subject, feeling that it is one of the most important problems with which the department is confronted at the present time.

The refuse and waste collected and disposed of by the city may be classified as follows:

(a) Garbage.

(b) Papers and other combustible material.

(c) Ashes and other incombustible material.

(d) Street scrapings and sweepings.

(e) Material excavated from street catch basins.

(a) The disposal of garbage in Cambridge is now in the care of the overseers of the Poor Department. It is collected

by city carts, transported to the City Home, where most of it is sold to outside farmers, by whom it is carried away. This method of disposal has many objectionable features, and at some not distant day will have to be supplanted by a more modern and sanitary method of disposal. However, as the present method is in many respects fairly satisfactory, and as any radical change would involve a very large expenditure of money, and a loss of upwards of $10,000 in revenue, it is not considered best to make at this time any recommendations looking toward such a change.

(b) At present this class of material is more or less mixed by the householders with class "c," no strict separation being insisted upon. Part of the material is burned at the incinerator on Main street, and the rest is burned as well as possible in the open air at the various dumps.

Much well-founded objection is made to this method of disposal by residents near the dumps. Moreover, the dumps are not convenient and are being rapidly filled up. It is clear that this method of disposal must and should be soon abandoned and a different one adopted.

The most feasible plan seems to be to construct at the city yard on Raymond street, another incinerator. A strict separation should then be insisted upon and all of this class of refuse which cannot be sold should then be carried to the two incinerator stations and burned.

(c) Much the larger proportion of the refuse collected in Cambridge consists of ashes or other incombustible materials constituting class c. Data relating to the collection of such materials are shown in the accompanying table.

DATA RELATING TO COLLECTION OF CLASS C REFUSE.

Year	Carried to dump. cu. yds.	Carried to Incinerator, cu. yds.	Total Cubic Yards	Total Cost of Collection per year	Cost per Cubic Yard
1900	70,656			$27,999.94	$0.396
1901	85,756			28,829.92	0.336
1902	89,549			28,999.94	0.323
1903	87,636			28,797.78	0.328
1904	103,426			32,096,98	0.310
1905	100,084			32,499.23	0.324
1906	106,106			33,686.46	0.316
1907	113,604			37,458.48	0.329
1908	99,486	23,415	122,901	40,152.36	0.319
1909	109,799	22,347	132,146	44,599.62	0.337
1910	120,667	20,956	141,623	47,099.23	0.335

The refuse of this class not carried to the incinerator is mainly carried to dumps situated as follows:

Near Brookline bridge.
Near the foot of Pleasant street.
Near Bird's pond.
In an old clay pit near Concord avenue.
In a clay pit near the city yard no Raymond street.

All these dumps, except the last, are nearly filled and are the subject of complaint from persons owning property near them, and therefore they cannot be used for this purpose much longer. Furthermore, in many cases the haul to them from the points where the refuse is gathered is so long as to make the cost excessive.

(d) In addition to the daily cleaning of the paved streets, twice a year at least, all the public streets of the city are scraped and the material so gathered has to be removed and disposed of. This in the past has been accomplished largely by filling low lands, and raising the grade of yards and lots at the request of the owners. It is being found increasingly difficult to find places of disposal for this heavy material without making very long hauls at correspondingly increased cost.

(e) The material taken by the Sewer Department from the street catch basin is generally regarded as more obnoxious than the refuse already referred to, and it is correspondingly difficult to find any place in Cambridge where it may be dumped.

It is clear that steps must be taken to secure some better method of disposal for the three classes of refuse last referred to at an early date, and to this the commission has given its attention.

In the extreme western parts of the city are located a number of disused clay pits which would require something over two million (2,000,000) cubic yards of filling to bring them to the original grade. These clay pits are controlled by one corporation, the New England Brick Company, and it seems that some equitable arrangement might be made with the company by which the city could fill these pits without charge to either party.

If this can be done the problem becomes one of economical handling and transportation.

As already shown, the total quantity of class "c" refuse collected in 1910 was 141,623 cubic yards. Of this quantity 20,956 cubic yards were taken to the incinerator, where similar materials will continue to be carried. Of the 120,667 cubic yards of other refuse collected, about 37,262 cubic yards were collected by the city ash carts in districts within convenient hauling distance of the pits. If the new method of disposal to be proposed had been in use in 1910, this quantity of refuse would have required no special method of transportation. There would have remained about 83,400 cubic yards to be transported to the pits, or otherwise disposed of. It is estimated that of this quantity 25 per cent. was paper, which in the future should be carried direct to the two proposed incinerators, leaving 62,554 cubic yards as the amount of refuse class "c" collected in 1910 to be disposed of in some other manner—as, for example, dumped into the clay pits.

The average weight of this class of material was found to be 1,150 pounds per cubic yard, so that the total weight for the year 1910 would be about 36,000 tons.

The amount of street scrapings taken up yearly is estimated at 17,200 cubic yards, or about 18,323 tons. Of this 4,583 tons can be carried to the pits direct from the areas adjacent, leaving 13,740 tons to be transported by some new method.

The amount of material removed annually from catch basins is estimated as about 3,129 cubic yards, or about 5,000 tons. Of this about 1,250 tons can be carried direct to the pits, and the balance, about 3,750 tons, must be transported by special conveyance.

The estimated present amount of refuse to be transported by special methods would be as follows:

Class (c)	62,554 cu. yds., or	36,000 tons
Class (d)	12,733 cu. yds., or	13,740 tons
Class (e)	2,344 cu. yds., or	3,750 tons
Totals	77,631 cu. yds., or	53,490 tons

The daily quantity to be transported varies greatly. The largest amount of class "c" was collected in December, 1910, 172 tons. The smallest amount was collected in August, 1910, 90 tons. Collection of class "d" occurs mostly in April and October, the maximum amount to be transported being about 228 tons daily. The collection of class "e" is fairly uniform, about 24 tons daily. Thus the maximum requirement might be, for April or October, as follows:

Class (c) average amount $\frac{72+90}{2}$	131 tons
Class (d) average amount	228 tons
Class (e) average amount	24 tons
Total	383 tons

The minimum during August would be as follows:

Class (c)	90 tons
Class (e)	24 tons
Total	114 tons

Recommendations.

First.—It is recommended that a strict separation be made by citizens of class "b" from class "c" refuse.

That a new incinerator of simple, yet suitable, design be constructed at the Raymond street yard, and that all of class "b" refuse be taken in suitable carts to the two incinerators and the material there disposed of either by sorting, pressing, baling and selling, or destroyed by burning, as shall be found most economical and practical.

Second.—It is recommended that steps be taken to secure the right to use the clay pits above referred to as dumps for classes "c," "d" and "e" refuse.

Third.—That the refuse collected in the western part of the city be taken to the proposed dumps by carts in which it is collected.

Fourth.—That the collection of refuse class "c" from the rest of the city be made by flat platform wagons carrying steel refuse tanks or boxes, which may be easily transferred to other means of conveyance to the dumps.

The collection of class "d" refuse could be done partly by the same method. The balance could be collected by carts, etc., and transferred by temporary means to the transportation vehicles. Class "e" refuse would be collected in tight covered tanks or small wagon bodies and transferred in the same manner.

Fifth.—That five and possibly six central stations or yards be established in the central and eastern parts of the city, to which the wagons will bring refuse in cans.

These stations to be located as follows:

1. Incinerator yard on Main street, near Ames street.
2. Portland street, rear of hook and ladder house.
3. City lot on Norfolk street, or city lot on Harvard street, near corner of Prospect street.
4. City lot on River street, corner of Blackstone street.
5. Some lot to be selected near Harvard Square.
6. Lot on or near Baldwin street.

Sixth.—Install at each station suitable appliances for transferring by power the tanks or boxes from the collecting wagons to the transportation vehicles and reverse.

Seventh.—The question of the best

method of transportation of the material from the stations to the dumping pits, the commission has been unable to decide. Two methods have been suggested and considered—the first, the Boston Elevated Railway Company is to lay sidetracks into the yards of the several stations and connect them with the tracks of the company in the street. A track is also to be carried from the Concord avenue track at Huron avenue to the pit near Sherman street, a distance of about one-half mile, where a power derrick would be set up for taking the tanks from the cars and swinging and dumping them into the pit. All this to be paid for and owned by the city. The railway company to furnish cars, wiring and operators, at rate per hour or per diem to be agreed upon.

The right to transport material of any kind through the city streets by the railway company is dependent upon the permission to do so being granted by the city council, and this has recently been refused, so that unless special permission to transport the material is granted, this plan would be impracticable. It might be found advantageous to the city to grant permission to transport its own refuse.

By the second plan considered, the transportation of the refuse collected is to be done by means of gasoline motor trucks, using the same stations, equipped with suitable transferring devices, the trucks to be owned by the city and operated by men in the employ of the city.

An approximate estimate of the outlay required shows that whichever plan is adopted an expenditure of from $80,000 to $100,000 will be required for the necessary equipment, land for stations, collecting wagons, cranes and other equipment.

It shows also that the cost of transporting the material from the central stations to the dump will probably be from 30 to 50 cents per ton, not including the cost of collecting and delivering it to the central stations, which will be reduced from the present cost of collecting, owing to the more convenient location of the stations to which the deliveries will be made.

It is apparent from the above figures that either of these methods of transportation will render the disposal of refuse more expensive than it is at present. As long as the present dumps hold out, or their use is permitted, it will be more economical to continue to carry the refuse to them. It would seem wise, however, to take preliminary steps toward the adoption of a more complete and lasting method of disposal, by securing, first, the dumps themselves, and, second, the two lots which will be needed for central stations. We would recommend that immediate action be taken on these two suggestions.

Contracting Practice.

By DeWitt V. Moore, Mem. Am. Soc. Eng. Contr., Indianapolis, Ind.

Final Analysis.

WE have reached the point where, in logical sequence of events, our outline of work is completed and we are ready to make a final analysis and summary of our results and experience. This thought leads us back to the June issue, wherein several definitions of analysis are given.

For the purpose of our final analysis probably the definitions; viz., No. 2, "Digest," that which is worked over, classified and arranged, and the definition No. 6, "Ratiocination," the necessity of reasoning, or probable reasoning, or the great principle of order in thinking, cataloging the accumulation of knowledge, putting us in shape to correct our own mistakes, are the best expressed for the purposes of this discussion.

It would seem that a very few have a proper idea of the meaning of the phrase "Cost Analysis." Time and time again articles have been called to our attention under the caption of Cost Analysis, which were nothing more or less than a bare statement of cost records, and although in a great many cases these cost records are divided in an intelligent manner to form the basis of cost analysis, still in no sense can they be said to be Cost Analysis as a Digest, or in the definition of Ratiocination or the great principle in order of thinking, cataloging our accumulation of knowledge.

It is true that to carry out to a full extent the meaning of Cost Analysis as we interpret same, it is necessary to have had an experience extending over more than one job, but it is presumed that we are dealing with contracting organizations having had experience, present activity and promise of future development. Under these conditions Cost Analysis implies a systematic study of results se-

cured on each job, so that any form of digest or cataloging information as illustrated by differences or inconsistencies are harmonized so that all the jobs are brought to a comparable basis.

In other words, Cost Analysis in this final summary eliminates non-essentials, individualities and specialties; reduces the pay hours of work, etc., to a uniform basis to the end that we may reach a point where the results can be tabulated on a comparative scale.

Such a Cost Analysis summary also implies a study of the work accomplished in a broader sense than simply as so many cubic yards of earth excavation, cubic yards of concrete, thousands of brick laid or feet board measure of lumber. Such an analysis takes into consideration the conditions under which such work was done, giving due credit for location of raw material and methods of operation, the extent of work under construction and the average unit of work.

In other words, we in reality are approaching the ideal which is to reduce our cost data to a basis of foot pounds of work, although we are only doing so in a very crude manner, inasmuch as we are using ordinary standards of measurement in order to introduce comparisons.

It is certainly true that the ordinary laborer is capable of so many foot pounds of work per day. If his time is expended in doing work at a long distance from the point of supply, his energy will be expended in distance at the expense of actual quantities handled. If, on the other hand, the work is arranged either naturally or by proper supervision, so that large quantities can be handled at a minumum of effort, the cost per unit of quantity is correspondingly decreased.

If we should attempt to completely analyze each and every job within the limit of practical supervision so that we might trace the foot pounds of work of each operation for each class of labor we would have a monumental task which would fail of real value through the difficulty and cost of securing information, but it is entirely possible to estimate on a basis of arbitrary units for the different classes of work, thereby giving us the same relative comparisons without difficulty. Such arbitrary assumptions based upon our familiarity with the work in question furnishes a definite basis of Digest or Cataloging of the information obtained.

As an instance of our idea in this connection, let us estimate a job in reinforced concrete.

The cubic feet of concrete to be placed in the building, bridge or other structure, divided by the square-foot area covered gives the average thickness of concrete in inches per square foot. This is an arbitrary indication of foot pounds of work necessary, inasmuch as it indicates without any direct statement of distance or haul the foot pounds of work and energy expended in order to place certain work. See Plate XXX. Such results are shown for reinforced concrete building work wherein a graphical form is shown, the increase in cost due to distance and decrease of thickness in work accomplished. The same style of a chart may be used for bridge work, pavements, sewers, sidewalks, etc.

Plate XXXI shows such a form of analysis as carried through the construction of the sewer job shown by Plate IV, with a special reference to the concrete work. In this case the arbitrary unit is the cubic yards of concrete per lineal foot of sewer.

Considering the subject of sewer construction leads us again to a consideration of Cost Analysis as applied to the construction and placing of steel centers or forms. To say that this cost is so much per lineal foot is insufficient, inasmuch as we are certain that the cost depends upon the size of the sewer, and the next job we have for estimate may give an entirely different size or a different proportion of sizes. Suppose, however, we analyze the situation and consider the square foot of forms set, taking the intrados of the arch, or in other words, the inner circumference, and reduce our cost to a square-foot basis, we find very interesting figures that are immediately valuable for future estimates on any other work.

To a certain extent the same results may be assumed to exist on pavement or sidewalk work both in the foundations and finishings. A four-foot width walk and a twenty-five-foot width street cannot be built for the same cost per square foot as a twenty-five-foot width walk or a fifty-foot street, that is so far as relates to the unit cost of work accomplished.

Cost Analysis is not cost recording, no matter how elaborated or how much in detail. Cost Analysis is based on cost records properly segregated, but the analysis eliminates unfamiliar items but making a note of same and places the different elements of work on a comparative basis reducing the quantities, units, hours and rates, so that all jobs may be compared on a certain definite uniform basis.

Much depends on the individual and therefore it is not possible to lay down any fixed rules. Illustrations accompany these articles, showing how these methods may be applied to practical and ac-

tual conditions, but exactly the same forms are not recommended for the readers hereof, it being our desire to suggest rather than to dictate and to develop the Cost Analysis turn of mind, which will prompt each man to formulate his own forms.

The writer of these articles is perfectly willing to offer free of charge to any reader of MUNICIPAL ENGINEERING his personal suggestions by letter to the end that the inquirer may receive the best results along the line of his own work.

The plates illustrative of Final Summary of Cost Analysis will appear in the March number of MUNICIPAL ENGINEERING, and it must be understood that these charts are based upon actual working jobs. In other words, there is nothing theoretical or visionary in this proposition.

The writer has had a practical contracting experience of twelve years, and it should be understood that the methods outlined during this series of articles are those in actual contracting practice within his own organization.

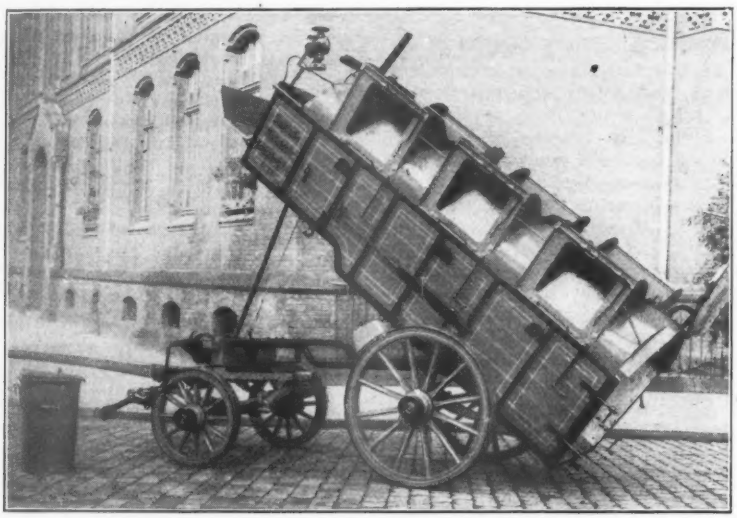
With the interested readers of this series of articles but of different ideas there is no quarrel. The facts are that not only in a small business but in large affairs these methods have proved satisfactory in practical experience.

In order to continue our idea of Cost Analysis Charts and present same in a form easily understood, it has seemed advisable to extend this series of articles to the March issue and include all the above mentioned forms at that time.

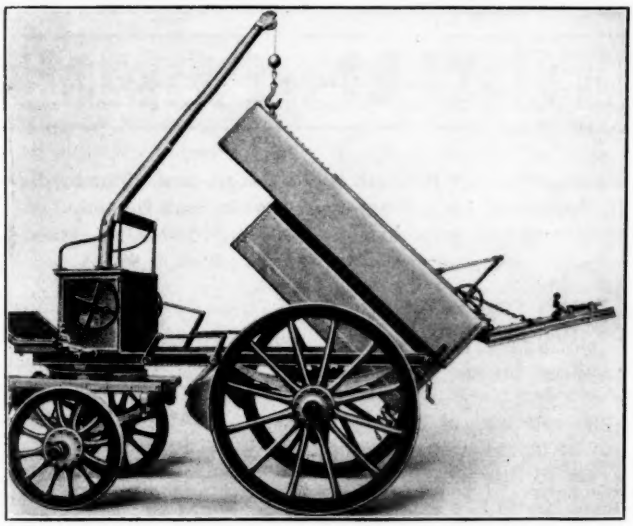
German Garbage Carts.

By Robert Grimshaw, Dresden, Germany.

IN the Dresden Hygiene Exhibition there are naturally exhibited several styles of garbage carts, one of which, built by the Casseler, Muellwagen & Geraetefabrik Co., and in use in several German cities, is here shown. The system is that in which the cart is filled from the house cans, and its contents as a whole are dumped by tipping the cart body about a transverse axis; over 100 German cities adopting this method. But the special feature is the method of filling it without causing dust or slop in the action, or allowing the odors from the cart to escape during this process. Another feature is that the cart can be turned very shortly, so as to permit it being used in narrow streets and alleys. The body has an angle-iron main frame and profile iron subsidiary frame, usually



1. A GERMAN DUMPING GARBAGE CART.
In Dumping Position, with Open End Gate and Screw Elevator for Raising the Front End.



2. A GERMAN GARBAGE CART WITH DUMPING CRANE.

with wooden panelling with feather and groove; the whole being lined with galvanized sheet iron; although sometimes the entire sides are of the latter material. The width is somewhat less in front, to facilitate dumping; there are two springs behind and three before. Dumping is accomplished by a screw resting on ball bearings and driven by a crank through bevel-gears without any ratchet device, as shown in Fig. 1.

On each side of the body there are three dust-tight arangements for filling from the cans, which latter are square in section and furnished with hooks by which they may be hung to the cart body while being tipped. The action of tipping them opens inwards a flap which otherwise closes the opening of the hopper, and which returns to place as soon as the can is removed. In some cases the cans are carried by two men between them; in others, on a two-wheeled cart.

A special cart or wagon shown at the Dresden Hygiene Exposition by the Vereinigte Fassfabriken of Cassel is, with exception of the wheels and the driver's box, entirely constructed of iron and steel. The running gear has four leaf springs; the fore axle can be turned square across; the axles are steel tubes; the wheels have iron hubs with dust-tight bronze bushings and constant lubrication. The whiffletree has springs to ease the draft in starting. The wagon box is closed water-tight, and is emptied by tipping to the rear about trunions at mid-height of the rear end. The rear axle is goose-necked, in order to bring the weight of the box and contents low down, but not so low as to hinder dumping clear from the wagon. The rear door is made water-tight by felt packing. The box, which holds 1.75 cubic meters or 61.8 cubic feet, is tilted by a crane, as shown in Fig. 2.

EDITORIAL COMMENT

Specifications for Wooden Block Pavements.—Standardizing Specifications.—What is the Matter with Business?—Selection of Administrative Officers of Municipalities.

SPECIFICATIONS FOR WOODEN BLOCK PAVEMENTS.

Some advancement in the knowledge of the action of wooden block pavements, and of the mutual relations of the methods of treatment of blocks and of laying them in the street to this action, seems to have been made recently, much of this being shown in the report on creosoted wood block pavements made in November, 1911, by John Ericson, city engineer of Chicago, and in the discussion of the report of the committee on wooden block pavements made at the recent New Orleans convention of the Association for Standardizing Paving Specifications.

Mr. Ericson's report shows excellent results obtained from various treatments of blocks with oils with specific gravity even as low as 1.03 and with specific gravity of not less than 1.09. He finds more trouble from "bleeding" of blocks and also from buckling of pavements under expansion on streets in Chicago laid under the latest specification requiring oil of 1.10 to 1.13 gravity than on streets laid earlier under specifications admitting the lighter oils. He does not attribute the increase in trouble to the oil but says it may be due in part to this or to character of wood, manner of treatment or of laying the blocks.

Indianapolis, which has had longer experience with wooden block pavements, reports some trouble with buckling on streets laid with blocks treated with oils of all gravities, light and heavy, and also some trouble with bleeding, but its specifications do not admit admixture of tar in the oil used for treatment.

Reports as to penetration of oil into blocks are equally various, good and poor penetration being reported with all grades of oil.

There was much complaint of the specification for an oil heavy enough to require the use of a considerable admixture of tar, which was passed by the A. S. P. S. at its New York meeting last year, by some on account of a supposed monopoly of the tar, by some because of the greater complaints of "bleeding" and by some because it prevented the laying of pavements treated with lighter oils, concerning which there was less complaint of "bleeding" and but little, if any, more complaint of buckling.

The committee of the New Orleans convention of the A. S. P. S. took cognizance of these complaints and offered an alternative specification providing for the use of oils of 1.03 to 1.08 gravity, which agrees with the specification proposed by Mr. Ericson in his report, although the specifications as to details of distillation results differ somewhat. The former specification of 1.10 to 1.14 gravity oil was retained, thus giving the engineer the choice of the two oils. These specifications preclude the use of oils of 1.08 to 1.10 gravity, in the face of the facts stated in Mr. Ericson's report that excellent results were obtained with oils of not less than 1.09 gravity, and without explanation as to why oils of this medium gravity should be so objectionable as to be cut out entirely.

Some have contended that the lighter gravity oils were necessary as preservatives and some have contended that the heavier gravity oils are necessary to waterproof the blocks and it seems to be true that the good oils of less than 1.08 gravity are free from tar while those above 1.10 must contain tar. The question immediately presents itself as to the propriety of excluding the oils between 1.08 and 1.10 which may be mix-

tures of the lighter and heavier oils and possess greater preservative qualities than the one and greater waterproofing qualities than the other.

All that precedes is simply indication of the chaotic state of our knowledge regarding the comparative values of the lighter and the heavier oils and mixtures of the two and of the necessity of further careful study. The block manufacturers represented at New Orleans seemed to be united in recommending the heavier oils, and their recommendations are worthy of the utmost consideration, but it is quite possible that investigation and experiment by men with their eyes not quite so close to the everyday operation of the plants may develop modifications of their ideas, especially in the light of facts presented in Mr. Ericson's report, made by such outsiders, and others of similar import.

Some of the facts stated by Mr. Buehler and other representatives of the manufacturers indicate that the troubles from bleeding and buckling, which are the principal troubles in wooden block pavements, can be remedied largely, if not altogether, by attention to other factors than the gravity of the oils. Mr. Buehler stated that expansion of the blocks after laying in the pavement could be prevented by keeping the block up to its maximum size until it is laid. He proposes to do this by taking for treatment blocks which are green or fully expanded with moisture, stating that these blocks, when the treatment is finished, will then be of their maximum size and can not further expand in the pavement. It is then a matter of the permanency of the oil in the blocks or the sealing of the blocks or the treatment of the pavement to keep the blocks up to their maximum size, or of the joints between the blocks to keep them always full so that contraction of the blocks, filling of joints with dirt, and subsequent expansion will not buckle the pavement. Both Mr. Buehler and Mr. Sibley recommended laying the blocks in a waterproofing bituminous layer to prevent absorption of water by the blocks from below, and the latter described a method of dipping two sides of the blocks in tar just before laying to further close the surfaces against absorption of water.

The report on wooden block paving specifications of the American Society of Municipal Improvements at Grand Rapids was held over for further consideration largely because of the desire expressed by one member of the committee that some of these details of treatment of blocks and construction of pavement should be worked out, the change in specification from light to heavy oils apparently not being sufficient to meet all the existing difficulties.

The question of monopoly may well be dropped out of consideration, first, because the main consideration is quality of pavement and not the business of supplying it, and second, because the question is rather one of the ability of the supply to meet the demand, and as creosote is made from coal tar the supply of creosote must always be less than that of coal tar. Mr. Ericson's report contains some interesting information upon this point.

If the state of knowledge regarding materials with which to treat blocks is chaotic, that regarding methods of treatment and methods of laying is almost equally so, and the specifications for wooden block pavements must still be open to improvement. The desire expressed in the modifications made at New Orleans to admit all good pavements and the information furnished by the manufacturers, much of which is stated above, indicate progress and it is to be hoped that the expert committee of the A. S. M. I. will make still further progress by the time of the next convention of that association in Dallas, next October.

Notwithstanding these complaints it is generally admitted that wooden block pavements have almost reached their highest point of perfection and the improvements asked for are the final touches needed to round out the rapid development of the past ten or fifteen years.

STANDARDIZING SPECIFICATIONS.

The procedure at the New Orleans convention of the Association for Standardizing Paving Specifications and the results obtained, when compared with those of the Grand Rapids convention of the American Society of Municipal Improvements demonstrate the superiority of the program followed by the latter society in several respects. This program was outlined in MUNICIPAL ENGINEERING, vol. xii, p. 370.

Both societies had committees at work during the year, but those of the former did not bring with them to the convention formulated reports. All the members of the committees did not appear at the convention and the vacancies were filled from those present, some of them not experts in the subjects covered by their committees and all unfamiliar with the year's work of the committee. Two of the committees had new chairmen and at least one had a majority of new members. The policy of closed committee-room doors was not enforced so that the discussions were more free than last year, but there was much loss of time in getting the new members of the committees into line on what had been done, and there was much hard work expended in educating the less expert members up to the standard of the best.

The reports formulated as the result of these committee-room discussions were necessarily somewhat hastily prepared and lacked the accuracy and finish which may be expected of reports prepared more carefully in advance so that there are definite statements to discuss and modify if necessary. Some of the committee chairmen confessed their inability to make reports satisfactory to themselves within the time set, and as a consequence the association felt itself but little, if any, better prepared to declare its work finished than after the New York convention. The double satisfaction of a report prepared by experts and presented after a full discussion before a judicial body, was lacking at this convention and increased this feeling of the need for further consideration.

A considerable proportion of the membership was on the committees, but there were some who had little to occupy their time from the adjournment of the first session Monday afternoon until the opening the second session of the convention on Thursday morning. This seems like a useless loss of time and demonstrates the economy of the program followed by the A. S. M. I. This program puts these committee-room discussions on the two days preceding the convention proper, and requires formulated reports as the basis of these discussions. This saves time in the committee room and the delegates to the convention who are not particularly interested in these discussions need not arrive until the convention proper opens. Much time is therefore saved the convention.

It is hardly to be doubted that the more carefully and expertly prepared specifications will be accepted as the most reliable and acceptable in case any differences should appear. Another reason for the specifications of the older society being more satisfactory is the fact that its membership includes not only city officials but also consulting engineers, chemists, and others who are specially expert in their respective lines at the same time that they are free from any commercial bias.

Full information about the New Orleans convention will be found in the report of its proceedings to be found elsewhere in this number. The principal changes in specifications adopted were the addition of alternative specifications for lighter oils for treating wood blocks; the addition of specifications for two-course bituminous concrete pavement; the abandonment of a water-bound macadam specification and the insertion of a bituminous macadam specification, penetration method, in place thereof. Rather important, though less extensive changes were also made in the brick and stone block specifications.

WHAT IS THE MATTER WITH BUSINESS?

So many articles on this subject have appeared of late that one more may not do any harm and possibly may do no

good, although the answer to be given to the question is "nothing." The trouble is to be found in the idea of what is good business rather than in business itself. The American business man has become so imbued with the idea that his business is a failure unless it shows a large percentage of gain over previous periods that he cannot bring himself to believe that it is possible to do business on a uniform basis or even on a basis fluctuating according to the demand, and still retain his self-respect.

Business boomers have preached this idea of growth as a measure of success until they have secured its general acceptance as a principle, though actually it is true in particular only for a certain period in the history of an enterprise and is true in general only during a certain period in the development of a country.

Big business, as that term is generally understood, is only possible, on the one hand during the period of rapid development of a young country or a new industry, or on the other hand by the smothering of competition when development has passed its rapid stages and has settled down to the steady rate which is inevitable. The former may in a sense be legitimate but the latter never is. The business which is in neither class should not attempt to imitate its more (or possibly less) fortunate contemporaries and should be content with such reasonable returns as industry, honesty and business ability may bring and should not attempt to create demands which do not exist legitimately.

That is the matter with business at the present time. We have reached a period of more leisurely development and our business men are not willing or possibly not able to recognize the fact and so they try to attribute the less rapid pace, the reduction in the rate of increase of demand, to any other cause or causes which may attract their attention.

It is doubtless true that suppression of competition and excess of competition, combinations and lack of combinations, tariff and free trade, labor and capital conditions, surplus and deficiency of currency, and many other pairs of opposites affect individual business or groups of business, but these effects are largely artificial, as are the conditions which produce them, and changes in them will inject artificial energy or produce artificial depression within certain limits. But the laws of supply and demand are far more extensive in their application and their full effect must be expected in the outcome no matter how many attempts are made to induce changes in their action.

Satisfaction with nothing less than the whole that legitimately belongs to the business, and the omission of no effort which promises to bring it, are principles essential to success, but recognition of the limitations of the field and of the impossibility of artificial stimulation without its consequent and inevitable reaction are no less essential to success.

Business men must recognize the latter as well as the former and then they will not so often ask "What is the matter with business?" They will provide for the possibilities of the future and will foresee, at least in part, the results of the operations which are in progress and as a consequence business will be more steady and the wrecks will not to so numerous nor so disastrous.

SELECTION OF ADMINISTRATIVE OFFICERS OF MUNICIPALITIES.

The cities act of the province of Saskatchewan, Canada, provides that the city council may appoint one or more commissioners, to serve with the mayor, who is ex-officio a commissioner, as the administrative officers of the city. The powers and duties of the commissioners are fixed by ordinance, which may be altered by the council at any time. With a few minor restrictions the control of the commissioners seems to be entirely within the power of the council.

In accordance with this law the city of Moose Jaw advertised for applications from qualified engineers to fill the position of engineer commissioner, leaving the provisions of the ordinance governing the office for determination in connection with the consideration of the ap-

plications for it. It was generally understood that the two commissioners, viz., the mayor and the commissioner to be appointed by the council, would have the oversight of the city engineering, electrical and health departments and that the salary would not be less than $5,000 a year.

After a month or so of consideration the council on January 2 decided to appoint L. W. Rundlett, formerly city engineer of St. Paul, Minn., as engineer commissioner at a salary of $6,000 a year and also appointed W. F. Heal, who has been city clerk, as a third commissioner at a salary of $3,000 a year.

The city also advertised for applications for the position of city engineer, and the time for reception of applications expired early in December. The appointment has apparently been delayed for the consideration and advice of the new commission, as the filling of the position is not yet announced. The advancement of Mr. Heal to the position of commissioner leaves vacant the city clerkship and advertisements are now made for filling this position at a salary og $125 a month.

Moose Jaw is a city which had a population of only 6,249 in 1901, but is rapidly increasing in population, in wealth and in business, indicated by an increase in the rateable assessment of $4,000,000 in 1911 and an increase of 100 per cent. in value of buildings for which building permits were issued.

The city has water and sewer systems, is constructing a modern sewage disposal plant and completed in 1911 a new incinerator plant and many extensions of sidewalks, pavements, sewers, water pipes and electric light lines. Plans for over $1,000,000 worth of new public and semi-public buildings are under way for construction in 1912.

The plan followed by the city of securing for consideration the applications of competent men for vacancies, and of making appointments for merit and without reference to citizenship or even to national boundary lines is one which is very generally followed in England and is notable as being the first important occurrence of the sort on this continent which has been so open to all available talent.

It is to be hoped that a fashion has been set which will grow in Canada and that it may extend to the United States. There is no information at hand as to the method of determining the qualifications of the various candidates for commissioners, nor as to the competency of the city council for making the determination, but the result thus far is highly satisfactory and these questions of detail must be settled for each individual case.

The general principle followed in this case has been discussed so often in MUNICIPAL ENGINEERING that it is not desirable to continue it at this time. It is enough to call special attention to this application of it that the workings of the method followed may be under observation by those interested. Much can be learned by study of the local developments both as to the value of the general method and as to the advisability of changes in the details of its application.

THE QUESTION DEPARTMENT

RMP

Books on Surveying.

Will you please tell if you can furnish the following books and price: Bagott's "Surveying" and Gillespie's "Treaties on Leveling." W. A. B., Millgrove, Ind.

The first volume of Staley and Gillespie's "Surveying" ($3.50) contains the treatises on land surveying and on direct leveling. The second volume on "Higher Surveying" ($2.50) contains full chapters on trigonometric leveling and precise spirit leveling. The other book mentioned is not known to the writer. The Gillespie books can be supplied at the prices named.

Restriction and Removal of Dangerous Buildings Within Fire Limits.

I write you concerning an ordinance for the destruction, removal, or condemnation of certain buildings within the fire limits of this city.

There are a number of old buildings within the fire limits of this city and they have become a menace to the other buildings, and I desire to draft an ordinance which will enable the city to abate such buildings.

Kindly send me any information you have along this line and if you know of any city where they have such an ordinance, that has been sustained by the courts, kindly inform me and I will try and secure a copy of the ordinance.

CALVIN STEWART, City Attorney,
Kenosha, Wis.

The city council has instructed me to draw an ordinance for the tearing down and removing at the expense of the owner some buildings that are unsightly and that endanger other buildings because they are "fire traps." Will you furnish me a model that will stand the test in this state?

M. A. GRAY, City Attorney,
Corbin, Ky.

In MUNICIPAL ENGINEERING, vol. xxxvii, p. 184, will be found extracts from the building ordinances of Cincinnati, O., and Dubuque, Iowa, covering this question, and some information regarding procedure in other cities. In vol. xxxviii, p. 271, are extracts from the ordinances of Atlanta, Ga.

All these ordinances refer more particularly to buildings damaged by fire or, in some cases, otherwise, or to permits for repairing old buildings, and possibly could be stretched in one or two cases to cover buildings which are dangerous as fire risks, though not otherwise.

The problem of removing usable buildings because they are dangerous from the point of view of fire is one which has never been solved completely, so far as the writer knows. The above cited ordinances approach as near it as any with which he is acquainted. It is quite possible that in some states it would be necessary to condemn such buildings and pay the damage resulting from their removal.

Can any of our readers cite valid ordinances more directly covering the conditions which our correspondents describe?

Form of Ordinance Assessing Cost of Sewer.

This city has just constructed a system of sewerage and Section 3 of the Act of the Legislature, authorizing the city to issue bonds for this purpose reads as follows:

"Be it further enacted by the authority aforesaid, That said city shall have the right and power to charge the owners of property along the line or lines of said sewer system when laid abutting thereon the amount of one-fourth of the actual cost along said abutting property and on each side of said line or lines."

I have been asked by the council to draft an ordinance providing for the assessment of the abutting property owners, as provided in the above section.

The bond money was expended in the construction of the sewerage system with the exception of about two thousand dollars. Please furnish me with all the information you can relative to the drafting of this ordinance, and oblige.

C. B., City Attorney, ———, Ga.

The exact form of the ordinance must be worked out by one familiar with the laws of Georgia and the charter of the city. The following, abstracted from the ordinances of Atlanta, may indicate what is sufficient for cities in Georgia, although evidently, details must be modified to conform with the differences in the charters of the two cities:

Whereas the sanitary consulting engineer, heretofore engaged by said city and the city engineer of said city, both advised the mayor and general council, prior to the introduction and passage of act hereafter referred to, amending the charter of said city relating to the construction of sewers by said city, that a proper and necessary system of sewerage for said city would cost on an average from $4 to $4.50 per lineal foot of said sewerage, small lines of sewers costing less and large lines costing more than said average, and it so appearing; and, whereas, the small lines costing less than said average, are dependent upon and drain into the large lines or sewers costing more than said average; and whereas, sewerage benefits the real estate in front of which and through which it is laid or constructed, and also benefits the general public of said city; and whereas, an assessment of 70 cents per lineal foot on the real estate abutting on a sewer on each side of a street in which a sewer is laid or construct-

ed; and an assessment of 70 cents per lineal foot on the real estate abutting on each side of a sewer laid or constructed through private property will realize an average of $1.40 per lineal foot of sewerage laid or constructed, less deductions for exemptions at street corners, which is less than one-half of the whole average cost; and whereas, the remaining cost of more than one-half thereof will be paid from the city treasury from appropriations for sewers; therefore, be it ordained:

All sewers laid or constructed by said city shall be laid or constructed under and in accordance with the act of the General Assembly of Georgia, amending the charter of said city, approved, November, 1889.

In all cases where a sewer shall be laid by or under the authority of said city in any street, the sum of 70 cents per lineal foot shall be assessed upon the property and estates respectively abutting on said sewer, on each side of said street, on which said sewer is laid or constructed, and in consideration of the payment of said assessment, the owners of said estates shall have the right to connect their drains from said abutting property for the discharge of sewerage into said sewer, and, in case any such sewer is laid down or constructed through or over any private property along the course of any natural drain or otherwise, a like sum of 70 cents shall be assessed upon said property abutting on each side of said sewer for every lineal foot, making in all $1.40 for every lineal foot to be assessed upon such property through which sewers are constructed, as aforesaid, and in consideration of the payment of said assessment, the owners of said estate respectively on each side of said sewer, through or over which such sewer shall be constructed shall have the right to connect their drains from said abutting property for the discharge of sewerage into said sewer.

(Section prescribing powers of mayor and council in constructing sewers and making assessments.)

The remaining cost of sewers not thus assessed shall be paid out of the sewer appropriations for the year; provided that the defendant shall have the right to file an affidavit denying the whole or any part of the amount for which the execution is issued, and stating what amount he admits to be due, which amount so admitted to be due, shall be paid or collected before the affidavit is received, and the affidavit received for the balance, and all such affidavits so received shall be returned to the superior court of Fulton county and there tried and the issue determined as in cases of illegality, subject to all pains and penalties provided in cases of illegality for delay.

(Section controlling connections with sewers.)

(Two sections providing for claims for damages for sewers through private property.)

In the case of real estate situated on street corners, and having frontage on two streets, the owner and real estate thus situated shall be assessed by this act provided for the frontage on the street in which the sewer is first laid, and where a sewer is laid on the other street 75 feet of frontage shall be exempt from assessment on the owner and real estate for the last named sewer

The amount of such assessment for sewers on each piece of real estate shall be a lien on said real estate from the date of the passage of the ordinance providing for the work and making the assessment.

The charter of the city provides authority to pass ordinances for the collection of assessments for the construction of sewers in installments running through a series of years to be fixed by such ordinances in all cases where the construction of the sewers is performed by contract.

The above ordinance, which follows the provisions of the city charter exactly, provides for assessments in proportion to frontage. The following provision of the charter of Savannah, Ga., also provides for frontage assessments for sewers with allowances for corner lots:

The rates which the breadth or face of any lot abutting on the line of any such drain bears to the length of such drain on said line shall be the ratio of computation of the amount to be assessed upon the owner of such lot as his pro rata of expense in the construction of such drain, it being understood that the total cost of construction of a primary drain shall be divided between the owners of the lots abutting on both sides of the street or lane, or portion thereof, through which said primary drain shall have been constructed; provided that when a primary drain lies abreast of one front of any lot, and a cross or trunk drain shall be constructed along another front of the same lot, no assessment shall be made upon said lot except for its pro rata apportionment of the cost of such primary drain; and provided further, that in the case of said larger cross drains or main trunk outlets, such assessments shall be distributed between the lot owners and the corporation as provided for in another section,, viz: the cost of a primary drain on the owners of the lots and the excess of cost of said larger drains over the cost of a primary drain upon the city.

These charters seem to indicate that the frontage method of assessment is popular in Georgia. In Indiana sewer assessments are made according to areas of lots and lands.

The question of methods of assessing cost of sewers is discussed to some extent in an article in MUNICIPAL ENGINEERING, vol. xxxviii, p. 191, in which are references to a large number of earlier articles on the subject, of which perhaps the most important are those in vol. xviii, pp. 252 and 247, and vol. xxi, p. 82.

Assuming that the Atlanta ordinance is sufficient in other ways, the principal point to discuss is the method of distributing the assessments. If the whole sewer system has been constructed, as seems to be indicated by the first paragraph of the question, any method which will make the assessment uniform will be satisfactory. If the lots are rectangular and of reasonably uniform depth, the assessment by frontage is practically equivalent to the assessment by area, provided the long sides of the corner lots are not counted in the frontage. This may be done even if the sewer is actually laid along the long side of some of the lots, as is doubtless the case, or there are sewers along two or more sides of a lot. If, however, the assessment is made according to area of lots, all these complications disappear and each lot receives its assessment in proportion to its area without any allowances of any sort.

The law, as quoted, provides that one-fourth the cost shall be assessed upon the abutting property, so that there is no provision for spreading an assessment on any

lot which is benefitted by the outlet for its drainage, supplied by the sewer, unless the sewer is in front of the lot. There seems to be nothing in the quotation from the law to prevent the assessment by area of abutting lots, and probably nothing to prevent the assessment by frontage omitting the long sides of corner lots, unless it be the last words "on each side of said line or lines." It seems hardly probable that these words could be construed to limit the assessment to the actual lengths on both sides of the street which abut on the sewer, thus exempting such parts of lots as do not have a sewer in front of them and requiring assessment of the long sides of corner lots when the sewers are on the long sides of the lots, and double or triple assessments when the sewers are on two or three sides of a lot.

The details of the assessment are left to the proper bureau by the Atlanta ordinance and it is necessary only to provide the general method in the ordinance.

The articles in MUNICIPAL ENGINEERING, above referred to, are based upon difficulties in making assessments and are worthy of study, containing, as they do, discussions of the principles underlying the methods of assessment described. Some help in the formation of the ordinance may also be derived from them.

Charges for Municipal Engineering Services.

Will you kindly give me information in regard to proper engineering charges on a percentage basis for paving, sewerage and other municipal work? I have been acting as City Engineer of a small city for several years and have found it hard to ascertain just what the custom is in this matter. Some say 4 per cent; some 5 per cent, and others 6 per cent. There is also a difference of opinion as to whether this includes just the preparing of plans and specifications, or the entire work.

I also would like to know what the custom is, as to inspecting. Is it the duty of the engineer to furnish an inspector on the paving and sewerage work, or should the city provide this at its expense? Perhaps you could answer the same questions in regard to drainage work when done under organized districts.

W., ———, Ill.

This subject is discussed to some extent in MUNICIPAL ENGINEERING, vol. xxxix, p. 36, and to a greater extent in vol. xxxviii, p. 346, which article refers to still earlier discussions of the subject and to detailed schedules. The schedules of fees which have been proposed vary charges according to amount of money expended. For work costing from $50,000 to $100,000, one schedule works out a charge of 2.3 per cent for surveys, plans and specifications and 2.8 per cent for engineering superintendence and inspection of construction, or 5.1 per cent in all. For work costing less than $50,000 the total percentage varies from 6.1 per cent if the work costs over $20,000 to 10.2 if it costs less than $5,000. The superintendence and inspection increase most rapidly as the cost of work decreases, because of the delays in small work which take the time of the inspectors and engineer much more in proportion to the cost of the work than in large work where several inspectors may be necessary. It would seem to be most satisfactory for the city to employ its own inspectors for small jobs, provided men satisfactory to the engineer and subject to his direction can be obtained, in which case his fees without supervision of construction might range from, say, 2.5 to 5 per cent as the total cost of the work drops from $50,000 to less than $5,000. From 1 to 2 per cent should be added to this for supervision of construction in case the inspection is paid for by the city but is done under the direction of the engineer.

Our readers may have some suggestions to make on this subject; if so they will be published if sent in for that purpose.

Should Earth Work Be Paid for in Both Cut and Fill?

The specifications for the construction of concrete sidewalks and cross walks provide.

"GRADING. That portion of the streets, avenues and alleys to be covered by the walks heretofore described shall be brought to a sub-grade by excavating or filling, as the case may be, the cross-section to conform in every respect to the cross-section of the finished walk, and having its upper surface a distance below the grade heretofore given equal to the thickness of the finished walk. The sub-grade shall be tamped or flooded, if necessary, so as to bring the same to a compact and even surface. Fills exceeding 1 foot in thickness shall be made in layers of not exceeding 6 inches and thoroughly compacted by tamping or flooding. The top of all fills shall extend at least 18 inches beyond the edges of the walk, and the sides shall have a slope of not less than 1 vertical to 1 1-2 horizontal. All soft and spongy places shall be dug out and depressions filled with suitable material and thoroughly compacted by flooding."

"SURPLUS EARTH. All material and surplus earth shall remain the property of the city and shall be removed and conveyed by the contractor to such places as the Board of Local Improvements shall designate, a distance not to exceed 500 feet. Excavation shall be paid for by the cubic yard and shall be measured in excavation only. No materials for sub-grade shall be borrowed, except upon the permission of the Board of Local Improvements or their engineer."

Also under GENERAL CLAUSES:

"1. The contractor shall be required to carefully set aside whatever blocks, planking, cobble stones, crossing stones, macadam, brick or any other material that may be in the walk, and he shall deliver the same wherever directed by the engineer. The length of the free haul not to exceed 500 feet."

"19. The plans and specifications are intended to be explanatory of each other; but should any discrepancy appear or any misunderstanding arise as to the import of anything contained in either, the decision of the engineer shall be final and binding on the contractor; and all directions and explanations required, alluded to, or necessary to complete any of the provisions of these plans and specifications and give them due effect, shall be given by the said engineer."

"20. The contractor shall furnish all the necessary ways and means for the transfer of the material to its proper place."

"22. The contractor shall do such extra work as may be required by the Board for the proper construction or completion of the whole work herein contemplated; he shall make no claims for extra work unless it shall have been done in obedience to a written order from the said Board or their duly authorized agent; all claims for extra work done in any month shall be filed in writing with the engineer before the 10th of the following month; failure to file such claims within time required shall forfeit all claims for such extra work. The price to be paid for all extra work shall be its actual reasonable cost to the contractor, as determined by the engineer, plus 10 per cent."

"24. In the interpretation of these specifications and upon all questions concerning the execution of the work, the decision of the Board of Local Improvements shall be final."

The proposal has an item of "10,900 cu. yds for excavating, grading, preparing subgrade, and doing all work described under term "grading" in specifications, per cu. yd., 25 cents," a total of $2,834.

The contract contains the same description of work to be done and price per cubic yard but not the quantity estimated.

There was something over 14,000 cubic yards of excavation and 3,000 cubic yards of fill, and some of the fill was hauled half a mile. The excavation was dug out and thrown outside and what fills were made were taken and hauled in wagons from the dirt that had been thrown out and from borrow pits.

It is claimed by the contractor that he should be paid for excavating per cubic yard and for making fills, and by the city that pay should be for excavating only.

L., ———, Ill.

A careful reading of the paragraph on "Surplus Earth" above indicates that the measurement of earth-work shall be in excavation only. This is customary and for earth excavated from one part of the work and placed in another part pay is due but once, on the measurement of the excavation. Where the Board permits taking materials from borrow pits the material so moved should also be measured at the excavation and not in the embankment.

It is evident from two of the quoted clauses of the specifications that free haul of materials does not exceed 500 feet. If, therefore, either earth excavated from one part of the work and deposited in another, or earth excavated from the work and hauled outside to a dump, or earth excavated from a borrow-pit and hauled to a place on the work, is hauled more than 500 feet, the over-haul should be paid for.

The profile from which the 10,900 cubic yards of excavating and grading given in the proposal was computed should show whether this was all excavation or included both excavation and fill on the work, and in that case would show whether the statement made above agrees with the original intention of the engineer who made the plans and prepared the specifications and the schedule of quantities.

The provision that no materials for subgrade shall be borrowed except by permission of the Board is at least a partial confirmation of the conclusion that it was the intention of the engineer to use earth excavated from the job as far as possible. The most obvious conclusion to be drawn from this is that the borrowed earth paid for in excavation would cost more than the earth from the job, which would be true if the earth from the pob was free, except for overhaul, unless the over-haul were quite long, and so the amount of such borrowed material was to be kept under the engineer's control.

The omission of over-haul from the schedule of quantities and the failure to call for a price for over-haul makes it necessary to fall back on the provision for payment for extra work at actual cost to the contractor plus 10 per cent. Under the contract this must be determined by the engineer.

Forms of Ordinance for Sidewalk Construction.

I would like you to send me a copy of an approved city paving ordinance, preferably one of some city in Alabama, if possible. We wish to put down sidewalks in certain parts of town, and will probably be opposed in our efforts to put them down, or in our efforts to collect for same as assessments against the property. I wish to be careful in the drawing of the ordinances providing for these matters and would like such information upon such proceedings as you can give me.

J. H. J., City Attorney, ———, Ala.

The writer does not have at hand an ordinance passed by an Alabama city concerning the construction of sidewalks. The Statutes of Alabama are quite specific on this subject as shown by the following sections reproduced from the political code of the state:

Sec. 1266. Cities and towns * * * shall require the sidewalks to be kept in repair and if not repaired by the owners of property abutting thereon, upon reasonable notice, to be determined by the council in the manner to be provided by ordinance, they may be repaired by the municipality at the owner's expense, and the amount expended shall be a lien upon the property, which, with interest, may be collected as taxes or assessments.

Sec. 1358. All cities and towns in this state may design or cause to be designed, contract for, and to execute or cause to be executed the construction or improvement, or the reconstruction or reimprovement, of any street, avenue, alley, highway, or other public place, of any sidewalks thereon, by filling, grading, leveling, graveling, slagging, macadamizing, curbing, guttering, paving, or otherwise improving the same, in such manner and with such material as the council of such city or town may prescribe; * * * and to cause the cost and expense of all or any part of the aforesaid works and improvements to be assessed against the property abutting on said street, avenue, alley, highway, or other public place so improved or drained by said sewer or sewers to the extent of the increased value of such property by reason of the special benefits derived from such improvements.

Sec. 1361. When the council of any city or town shall determine to construct or improve any street, avenue, alley, sidewalk, highway, or other public place, or to make any other improvement or undertake any work authorized, the cost of which, or any part thereof, it is proposed to assess against the property abutting on or drained by said

improvement, it shall adopt an ordinance or resolution to that effect, describing the nature and extent of the work, the general character of the materials to be used, and the location and terminal points thereof, and the streets, avenues, alleys, or other highways, or parts thereof, and shall direct that full details, drainings, plans, specifications, and surveys of said work and estimates he prepared by the city engineer, or such other person as may be designated in such ordinance or resolution, or the said council may adopt plans for such work already prepared.

Sec. 1362 provides for filing plans for examination by property owners and for hearing objections or remonstrances as to the improvement or manner of making or materials to be used, not less than two weeks after first publication of ordinance.

Sec. 1363 provides for publication of ordinance.

Sec. 1364 provides the program for the meeting to hear objections and stoppage of improvement by a remonstrance from owners of a majority of the frontage, unless overridden by two-thirds vote of council.

Sec. 1365 provides that council may pay any portion of the cost from city funds, and that the cost includes all the preliminaries, supervision, notices, etc.

Sec. 1366. Before the passage of the final resolution or ordinance to make any improvement on any street, avenue, alley, or sidewalk, the cost of which, or any part thereof, is to be assessed to the abutting property, if the grade of such street, avenue, alley, or sidewalk has not been established, or if said improvement necessitates a change of grade, the council shall by ordinance fix and establish the grade of such street, avenue, alley or sidewalk about to be improved, and also the grade of the curb on each side thereof.

Secs. 1367-1372 provide for letting contract, supervising work, accepting same, power to levy taxes and methods of levying taxes for sewers, drainage and street intersections.

Sec. 1373. In case of sidewalk improvements, including curbing, the costs, or any part thereof, of the improvement of the street or avenue corner, may be assessed against the lots abutting on or nearest said improvement, and the entire cost or any part thereof of the improvement at the intersection of any alley with a street or avenue, or other highway, may be assessed in fair proportion against the respective lots or parcels of land abutting or cornering on the alley at such intersection; provided, however, that in no case shall the assessment against any lot or parcel of land be greater than the increased value of such lots or parcels of land by reason of the special benefits to be derived from such improvement.

Subsequent sections provide methods of preparing assessment rules and books, notice of same, hearings of objections, fixing of final amounts of assessments by order or resolution of council, enforcement of the assessment liens thus created, appeals, executions, etc.

In MUNICIPAL ENGINEERING, vol. xxxvi, p. 30, will be found two forms of ordinance in use in other states which cover the case very completely, and are evidently prepared for use under statutes containing provisions almost identical with those quoted above. An ordinance can doubtless be drawn from them which will fit Alabama conditions exactly. In vol. xxxvii, p. 238, is another brief article on the same subject.

Articles on Mineral Rubber Pavement.

Will you please advise us of the date of any articles which have appeared in your publication describing the mineral rubber pavement as laid by the South Park Commission, Chicago. And if you have back files of your magazine, could you supply us with copies in which these articles appear? This courtesy will be much appreciated.

J. M. W., Chicago, Ill.

The mineral rubber pavement laid under the Chicago South Park Commission was described by Linn White, engineer of the commission, in a paper before the American Society of Municipal Improvements at its meeting in 1908. It will be found in the volume of proceedings of the society for that year. An abstract of the paper was published in MUNICIPAL ENGINEERING, vol. xxxv, p. 372.

Cities Owning Their Asphalt Paving Plants.

I am desirous of obtaining a list of those cities in the United States which have (own or operate) municipal asphalt plants for paving, and the names of the mayors of such towns.

D. B. G., New York City.

Following are the names of cities owning their asphalt repair plants, some of which are used also for paving new streets and resurfacing old pavements.

San Francisco, Cal.—The Hetherington & Berner plant. P. H. McCarthy, mayor; Marsden Manson, city engineer.

San Jose, Cal.—Small inprovised repair plant. Charles H. Danson, mayor; Charles H. Pieper, city engineer.

Denver, Col.—Hetherington & Berner plant. Robert W. Speer, mayor; George A. Collins, city engineer. S. R. Murray, superintendent in charge of the plant.

St. Augustine, Fla.—Hooke portable repair plant. Eugene Masters, mayor.

Decatur, Ill.—Hooke portable repair plant. C. M. Borchers, mayor.

Joliet, Ill.—Small repair plant. John R. Crowin, mayor; H. A. Stevens, city engineer.

Bluffton, Ind.—Hetherington & Berner plant. A. W. Hamilton, mayor; B. A. Batson, city engineer.

Indianapolis, Ind.—Hetherington & Berner plant. S. L. Shank, mayor; H. W. Klausmann, city engineer.

Marion, Ind.—Hooke portable repair plant. John C. Willson, mayor; T. E. Petrie, city engineer and street superintendent.

New Orleans, La.—Warren plant. Martin Behrman, mayor; W. J. Hardee, city engineer.

Detroit, Mich.—Hetherington & Berner plant with additions from F. D. Cummer & Son. P. H. Breitmeyer, mayor; Jacob J. Haarer, commissioner of public works; R. H. McCormick, city engineer. C. A. Proctor in charge of the plant.

Kansas City, Mo.—Warren plant. Thomas P. Crittenden, mayor; L. R. Ash, city engineer.

St. Joseph, Mo.—Repair plant. A. P. Clayton, mayor; D. L. Lawler, city engineer. Henry L. Meyer, superintendent of plant.

Omaha, Neb.—A specially-designed plant

Frank E. Moores, mayor; George Y. Craig, city engineer.

Newark, N. J.—Hooke and local portable repair plants. Jacob Haussling, mayor; M. R. Sherrerd, chief engineer; William A. Howell, engineer of streets and highways.

Brooklyn, N. Y.—Warren plant. John C. Sheridan, chief engineer bureau of highways; W. H. Broadhurst, chemist. Charles K. Leonard, superintendent of plant.

Syracuse, N. Y.—Hooke portable repair plant. Edward Schoeneck, mayor; H. C. Allen, city engineer.

Watertown, N. Y.—Hooke portable repair plant. Francis V. Hugo, mayor; E. E. Sayles, city engineer.

Cincinnati, O.—Specially-designed plant. W. T. Hunt, mayor; H. F. Waige, city engineer.

Columbus, O.—Hetherington & Berner plant. ——— Marshall, mayor; Henry Maetzel, city engineer. W. W. Horn, superintendent of plant.

Dayton, O.—Hetherington & Berner plant. E. E. Burkhardt, mayor; F. J. Cellarius, city engineer; M. K. Huffman, superintendent of streets.

Toledo, O.—Repair plant. Brand Whitlock, mayor; G. W. Tonson, director of public service.

Sandusky, O.—Hooke portable repair J. J. Moller, mayor; C. M. King, city engineer.

Pittsburgh, Pa.—Specially-designed plant. William A. Magee, mayor; C. A. Findlay, city engineer.

Erie, Pa.—Plant designed by city engineer, B. E. Briggs.

Newport, R. I.—Hooke portable repair plant. P. J. Boyle, mayor; W. H. Lawton, city engineer.

Nashville, Tenn.—Warren bitulithic plant. A. S. Williams, mayor; W. W. Southgate, city engineer.

Chattanooga, Tenn.—Hooke portable repair plant. Robert Hooke, city engineer.

Houston, Tex.—H. B. Rice, mayor; T. C. Tarver, city engineer.

Fort Worth, Tex.—Downard-Lester rock asphalt paving plant. F. J. Powell, mayor; J. D. Trammell, city engineer; Sam Davidson, commissioner of streets.

Seattle, Wash.—John F. Miller, mayor.

Spokane, Wash.—C. Herbert, mayor; Morton Macartney, city engineer.

Milwaukee, Wis.—Guelich portable repair plant and heater and mixer for old materials. Charles A. Mullen, superintendent of streets; Harry E. Briggs, commissioner of public works.

Toronto, Ont.—Warren plant. Charles H. Rust, city engineer.

Kingston, Ont.—Small portable outfit.

Winnipeg, Man.—Specially-designed plant. H. N. Ruttan, city engineer. Warren Rodney, superintendent of plant.

Montreal, Que.—Warren plant.

Information About Water Works Plants.

I desire to obtain considerable information concerning water works plants, particularly those under municipal control in cities of population of from 6,000 to 20,000. Our city has a population of 10,000. I would appreciate very much if you will send me a list of 15 or 20 cities of population mentioned, cities for the most part western or middle western which have municipally owned plants. Also any general information on this subject which you may have at hand or statements as to where such data may be obtained will be gratefully received.

City Engineer, ———, Mont.

The following articles in recent numbers of MUNICIPAL ENGINEERING will give some information concerning water works in the smaller cities and names of cities owning their own plants.

In vol. xii: An article giving a list of cities in Indiana, Ohio and Kentucky between 3,000 and 10,000 population, whether public or private ownership, meter and flat rates, on p. 131; one giving references to a number of earlier articles on water rates and water works management on p. 291.

In vol. xl: "Charges for sprinklers and standpipes for fire protection," giving the practice in a large number of cities, on p. 120; new work of the years 1910 and 1911 is outlined on pp. 265 to 276; there is a good article on rate making on p. 319 and one on water works management on p. 493; the method of determining the water rates for Madison, Wis., is given in some detail on p. 502.

In vol. xxxix: Forms of water bills and schedules of rates in various cities will be found on p. 120; meter rates in gravity systems in all parts of the country classified as private and municipal plants are given on p. 208; a list of combined electric light and water plants is given on p. 387.

In vol. xxxviii: Forms of water bills and schedules of rates are given on pp. 184, 347 and 423; there is a list of cities having both municipal and private plants on p. 185.

In vol. xxxvii: An article on "Depreciation and Water Rates" on p. 183, gives also references to many previous articles on allied subjects. Valuable data regarding water supplies for cities of 25,000 to 50,000 population will be found on pp. 258, 330, 401.

The list could be indefinitely extended. There are several articles in each of these and earlier volumes giving descriptions of works or of special features in existing works.

The following cities of about the populations named and west of the Mississippi river own their water works; Winona, Minn., San Diego, Cal., Treat Falls, Mont., Cheyenne, Wyo., Mankato, Minn., Sherman, Tex., Oklahoma, Okla., Guthrie, Okla., Fargo, N. D., Beaumont, Tex., Paris, Tex., Astoria, Ore., Emporia, Kan., Laramie, Wyo., Tyler, Tex., St. Charles, Mo., Vallejo, Cal., Faribault, Minn., Marshall, Tex., Grank Forks, N. D., Grand Island, Neb., Tucson, Ariz., Red Wing, Minn., Fremont, Neb., Hastings, Neb., Whatcom, Wash., New Iberia, La., Santa Rosa, Cal., Baker City, Ore., Santa Barbara, Cal., Terrell, Tex., Newton, Kan., Provo, Utah, San Bernardino, Cal., Boulder, Colo., Arkansas City, Kan., Bonham, Tex., Kirksville, Mo., Iola, Kan., Santa Cruz, Cal., Alexandria, La., Owatonna, Minn., Brookfield, Mo., Austin, Minn., Logan, Utah, New Ulm, Minn., Hillsboro, Tex.,, Trinidad, Colo., Victor, Colo., Coffeyville, Kan., Santa Ana, Cal., Fulton, Mo., Grass Valley, ,Cal.,, Corpus Christi, Tex,. Junction City, Kan., Ballard, Wash,. Albert Lea, Minn., Pendleton, Ore., McKinney, Tex., Popular Bluff, Mo., St. Peter, Minn., Wellington, Kan.,, Waxahachie,

Tex., Crowley, La., Chanute, Kan.,, Osawatomie, Kan., Yankton, S. D., Donaldsville, La., Aberdeen, S. D., Mitchell, S. D., Victoria, Tex., Brownwood, Tex., Nerfolk, Neb., Navasota, Tex., Orange, Tex., Canon City, Colo., Aberdeen, Wash., Moorhead, Minn., Florence, Colo., Salida, Colo., Ely, Minn., Belton, Tex., Santa Clara, Cal., Sulphur Springs, Tex., Oak Cliff, Tex., Eureka Springs, Ark., Prescott, Ariz., The Dalles, Ore., Columbus, Neb., Grand Junction, Colo., Deadwood, S D., Oregon City, Ore., Richmond, Mo., Cherryvale, Kan., Shawnee, Okla., Olathe, Kan., Enid, Okla., Manhattan, Kan., Cuero, Tex., Bozeman, Mont., Abilene, Tex., Willmar, Minn., Concordia, Kan., Paragould, Ark., Durango, Colo., Two Harbors, Minn., Rosedale, Kan., Thibodaux, La., Nevada City, Cal.

The list of private water companies is somewhat longer than the above.

Much special information regarding the water works in medium and large sized cities is on file in this office and can be supplied in response to specific questions as to what is wanted. Direct reference to articles regarding special water works questions and descriptions of works can often be made upon specific request.

The volumes of MUNICIPAL ENGINEERING have much information upon all water works problems. Other prolific sources of infarmation are the annual volumes of proceedings of the American Water Works Association, John M. Diven, secretary, Troy, N. Y., and the more frequent issues of the journal of the New England Water Works Association, Boston, Mass.

Municipal Ownership of Water Power.

I have a proposition put up to me which involves the combining of a number of water powers owned by private owners all of which are lower down on the stream than a fairly good power owned by the village. I have been asked what to do about the matter. The idea seems to be to bring about municipal ownership of one large power. Have you any suggestions?

L. R., ———, N. Y.

It would seem necessary first to determine the powers of the village regarding ownership of water powers and condemnation of others desired under the plan proposed, so that there may be no insurmountable obstacle in case some one or more of the private owners should not be willing to sell without legal proceedings for condemnation. This is a question for an attorney familiar with the New York constitution and statutes and may be complicated by the question as to whether the proposedF combination is for public purposes or for the convenience of private power users.

Second, a competent engineer should make a thorough study of the proposition as regards methods of making the combination, making preliminary plans and estimates of cost of construction and operation, so that the results can be compared with the present conditions and with the utmost improvements possible under the present conditions. This study should be based on ample surveys and observations of rainfall, runoff, available running water and storage, control of floods, etc., etc. These surveys, plans and estimates will cost some money if the good engineers required for an adequate report are employed, but they will save their fees many times over if they prevent entrance upon an impracticable scheme, or by setting the village on the right way to construct the most economical and efficient system to secure the best results possible.

Further steps, after these two fundamental steps have been taken, will show themselves at the proper time.

Slag for Concrete.

Please advise me if you have information on the use of iron furnace slag for aggregate in concrete. It is abundant and cheap, while we pay in carloads about $1.50 per cu. yd. for gravel. It seems that slag might be used, but I have not known of any use of it here. I have tried in a small way to set granulated slag in cement and find only very partial success. I find it hardens quite well on the surface but not throughout. Probably yourselves or the cement chemists can tell us how this may be done or the reasons why it cannot. But aside from this, if the lump slag can be used for coarse material successfully, that would be a help.

C. E. V., East Palestine, O.

There seems to be no reason why slag, broken to proper sizes, should not be used for concrete. It is hardly probable that the slag named by our correspondent would be different enough from other slags to produce an injurious effect upon the cement. Slag cements are made by grinding lime and slag together and are intermediate in qualities between natural and Portland cements. Finely-ground slag has been used as an adulterant for Portland cements, but its use is prohibited at the present time.

In the "Handbook for Cement Users" ($3) it is stated on authority of Joseph A. Shinn that mortar made of Portland cement and slag sand has from 10 to 36 per cent. greater tensile strength than mortar of the same proportions using river sand. Most of the text-books on concrete name slag, crushed to proper sizes, as an acceptable material for concrete. English experiments, quoted in Potter's "Concrete" ($3), show that slag concrete compares favorably with concrete of other standard materials in compressive strength. Our correspondent's experiments indicate that some study should be given to the special slag available, that its qualities and the best method of using it may be determined before the specifications governing its use are adopted. There is nothing in them which would demonstrate that it is impossible to use the slag, especially for mass concrete, pavement foundations, and the like.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited.
Give from your experience for the benefit of others.
Never mind style of composition, the fact is what is wanted.

Characteristics of Bituminous Highway Materials.

In the article by Clifford Richardson on the above subject, which appeared on page 41 of the January number of MUNICIPAL ENGINEERING is a table the heading for which was inadvertently omitted. The table with its head should read as follows:

	Density of Test Piece	Cementing strength lbs. per sq. in. 38° F.	77° F.
Coal tar pitch 15 percent...	2.16	3,884	1,254
Coal tar pitch 10 percent...	2.07	3,845	2,655
Land Pitch 10 percent. bit..	2.13	1,813	761
Bermudez cement 10 p.c. bit.	2.10	1,955	635
Lake pitch 10 percent. bit..	2.14	1.375	54

Treatment of Over-Exposed Blue Prints.

To the Editor of MUNICIPAL ENGINEERING:

Sir—For several months I have noticed so many proposed remedies for over-exposed blue prints, some of which cost as much as a cent a yard beside much trouble in brushing, etc., that I would advise your subscriber that if he will put ten cents' worth of potassium bichromate in a quart bottle of water, by using the liquid over and over again he can bring back his over-baked prints for several months. Our expense for this item for four years has been $1.80.

C. A. BINGHAM, City Engineer,
Carlisle, Pa.

Influence of Cold Wave on Setting of Concrete.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Although I have heretofore heard of the failure of the Prest-O-Lite building I have today read the article by D. M. Avey in the January issue of MUNICIPAL ENGINEERING.

This fall I had several concrete jobs under supervision and there was a time or particular period when, for some reason or other, the concrete did not set or harden. A particular case in mind is a concrete building, and during the last two weeks in November, 1911, the contractor was placing the concrete roof slabs in position. On November 25 we had a sudden change in temperature, a very heavy drop from 60 or 70 degrees above zero down to 18 degrees. There was a large piece of this roofing put in place on Saturday, November 25, but was covered late Saturday evening, and upon examination two or three days afterward it apparently had not frozen.

My advice to the contractor, however, was to leave the forms in position as long as possible. At the end of three weeks, however, he needed the form lumber and removed the form from under this slab. It immediately settled or sprung downward about four inches; it had a ten-foot span. Needless to say it cracked very badly, but did not fall. On examination I found that the concrete had still not set sufficiently to justify the removal of the forms.

Another case in mind was the foundation wall which was also a retaining wall placed on the same Saturday. The wall was not especially covered, but had the forms on both sides of it and was left about two weeks before removing the forms. I found that this work also had not sufficiently set to warrant the removal of the forms, but the wall remained in position. It is not a good wall today, as the concrete is not as hard as it should be for the time it has been built.

Another case of foundation, built on the same day, after setting three weeks was considered unsafe on which to build a brick wall and was removed and replaced with fresh concrete upon which a wall was built after seven days.

I have had experience in concrete work for thirty years and I have found in doing work in the fall of the year that occasionally there is a temperature proposition which apparently cannot be overcome on ordinary work on account of the inability to properly cover the work.

My conclusion is that in cement work that has not reached a certain period in setting and is reduced in temperature to almost freezing point there is considerable injury done to the cement. If not injury, this condition retards the setting qualities in cement so that it will not set for weeks or months afterward.

On the other hand, I have had the same

class of work frozen solid which remained so for perhaps a month or more, in which time an examination showed that the concrete was in good condition.

In Mr. Avey's article he speaks of the upper work on the Prest-O-Lite building being soft, not having set sufficiently. I have no doubt but that the contractor experienced the same conditions that we did on the building above mentioned and that the concrete work should either have been removed or else the forms should have remained in place for several months.

In all the work of which I speak the usual proportions were used and the same proportions and brand of cement as used in previous work and work since, which has turned out to be first class. I think a contractor or builder cannot be too careful in pulling the forms on any class of cement or concrete work when the temperature is as changeable and reaches as low a degree as it did the night of November 25. Even though the concrete has not frozen it may have been injured or retarded by the temperature.

J. J. WEAVER, C. E.,
Ludlow, Ky.

Wooden Paving Block Machine In Paris, France.

A rapid and economical paving block machine is in use in the municipality owned plant of Paris, France. This machine, which was invented by the director of the plant handles the material from the plank furnished to the finished block in a very efficient manner.

The planks are hand fed onto a conveyor which in turn delivers them to the machine. Two guides keep the planks in position, and assure their alignment when delivered on a horizontal cutting table. The planks are pushed along this cutting table by combs attached to endless chains. In front of each tooth of the combs is a spring which presses the planks against the horizontal table both before and after sawing. Brushes are provided at either side of the combs to sweep the waste material into slots provided for that purpose.

The first process of sawing is accomplished by two sets of saws each containing five saws. Each cuts a waste end of trimming and four blocks from each plank. These two sets of saws operate at the ends of the plank, and after the material is carried forward a third set of seven saws divide the remaining portion into eight blocks. Thus 16 blocks are cut from each plank and are carried along on the horizontal table to a stationary table which terminates in an inclined plane to another conveyor which carries them to workmen engaged in loading cylinder cars.

The machine is operated by a 110 h. p. motor; and is controlled, including the loading operation, by 20 men. The machine is 100 feet long, and as was noted has 17 circular saws of 25-in. diameter, which revolve at the rate of 2,000 r. p. m. The output is 24,000 blocks per hour.

The procedure in this country is very different from that noted above. While the output of the individual machines is not nearly so large, the method of handling is much more economical and efficient; for from the time the blocks enter the sawing machines until they are delivered to the paving contractors, they are not handled by hand in any process. The method of treatment after sawing is practically the same in both instances.

Financing Road Repairs in Japan.

A report from Consul General Thomas Sammons, at Yokohama, Japan, gives brief mention of the method of providing for road repairs in that country.

The last Cabinet put aside $85,000,000 as a fund for flood repair, but of all the bureaus in the newly organized Home Department the most important seems to be attached to that of public works. This bureau is planning two distinct kinds of work—harbor repair and road repair. One method proposed for carrying out these plans is that of granting subsidies to this or that prefecture or city and delegate the work to the local officials, while another plan is to require the local authorities to supply one-half or one-third of the total amount required, and the Government, supplying the remainder, is to place the work in the hands of competent engineers under its direct supervision.

It has heretofore been the policy to distribute a sum of $100,000 to $150,000 very promiscuously among the various prefectures, to be used in a general way for repairs to the roads. The plans of the new bureau, however, are more definite, and contemplate the separation of prefecture and Government roads, making separate appropriations for each.

Record of Water Fixtures and Meter Readings.

The accompanying diagram shows the form of record used in the water department of Jamestown, N. Y., for showing name and location of water consumer, kind of meter and fixtures used, meter readings and detail of charges. It is presented for criticism by our readers. As it stands it provides for nearly six years of an account. The sheet from which the reproduction was made has four times the area of the cut. There are one or two suggestions which will probably occur to many, such as the separation of the more permanent left half of the sheet and placing it on a card, with the consequent reduction in size of the book required for the continuing record of service rendered and payment therefor.

CONSUMER	LOCATION	FIXTURES	WHEN READ	READING	CUBIC FEET	DR. BAL.	CR. BAL.	CHARGE	DATE PAID	AMOUNT PAID	REBATE OR DISCOUNT	1234. DATE. ON	OFF
		SIZE TAP	OCT. 19										
		SIZE SERVICE	JAN.										
		LEN. MAIN TO CURB	APR.										
		COCKS	JULY.										
		STOPS	OCT.										
	METERS	STREET WASHERS	JAN. 19										
	NAME / NO. / SIZE.	ROOMS	APR.										
		BATHS	JULY										
		CLOSETS	OCT.										
		BOWLS	JAN. 19										
		SET TUBS	APR.										
		URINALS	JULY										
		HORSES	OCT.										
		COWS	JAN. 19										
		AUTOS	APR.										
		NO. PERSONS	JULY										
			OCT.										
			JAN. 19										
			APR.										
			JULY										
			OCT.										
			JAN. 19										
			APR.										

RECORD OF WATER FIXTURES AND METER READINGS.

MUNICIPAL MATTERS IN COURT

Higher Courts.—Obstruction of Natural Drain.

Decisions of the Higher Courts of Interest to Municipalities.

A Petition by a Land Owner Outside of the City Limits Does Not Authorize an Assessment on His Land—Where a trustee, holding title to land situated outside the boundaries of a municipality, signed a petition for the construction of a sea gate as a municipal improvement, the legal owner was not estopped to question the validity of a municipal assessment for benefits, on the ground of the location of the property, since the petition could not extend the assessing power of the municipality to lands beyond its boundaries. —Edmonds Land Co. vs. City of Edmonds (Wash.) 119 P. R. 192.

Reasonable Minimum Gas Charges Sustained —Unpaid Bills—An ordinance, enacted by a city furnishing natural gas to its inhabitants, is not presumptively unreasonable, because it requires a minimum charge of 50 cents a month, regardless of the amount of gas used, a rental of 20 cents a month for meters furnished for the use of tenants, and also provides that owners of tenant property, and not their tenants, will be dealt with, unless separate service pipes are supplied for each tenant using gas.—Cunningham, et al. vs. City of Iola et al., (Kan.) 119 P. R. 317.

Notice of Defective Sewer Plan Not Ncessary Before Damage Suit—Where plaintiff sued defendant city for flooding his mine, by reason of a defective plan adopted for the construction of a sewer, the cause of the injury was not a "defect," within a statute providing that notice of claim for injuries must be given before the city shall be liable for damages for any defect in a bridge, street, public work, etc.—Kelley vs. City of Butte (Mont.), 119 P. R. 171.

Second Condemnation Proceeding Not Invalidated by a Previous Action—A former proceeding by a city to acquire, by condemnation, land for opening a street, is not a bar to a second proceeding, more then five years later, and not covering the same property, there being nothing in the second proceeding to impeach the good faith of the city.—City of Chicago v. Walker et al. (Ill.), 96 N. E. R. 536.

Refusal to Correct Damaging Conditions in a Sewer After Notification Constitutes Willful Injury.—A complaint in an action against a city for damages by converting a sanitary sewer into a storm and surface water sewer, which alleges that plaintiff informed the city that he was being damaged by the sewerage backing up into his cellar, that the city refused to remedy the condition, but continued to connect other drains with the sewer thereby increasing the damage, and that the city knowingly and willfully and negligently turned large volumes of surface water into the sewer, states a cause of action for willful and intentional injury.—Union City v. Murphy (Ind.), 96 N. E. R. 589.

A Lease of Machinery for a Definite Number of Days is Invalid.—A contract between a town and a roller company, whereby the town was to have possession of a steam roller and to pay a rental of $10 per day for 64 days each year for five years, at the end of which time it might buy the roller for $1, even if a lease and not a sale,, is invalid under Highway Law ,Consol. Laws 1909, c. 25) Section 50, providing that the town superintendent may rent a roller at not exceeding $10 per day for each day it is actually used upon the highway; the town binding itself to pay for 64 days whether or not the roller was used that length of time.—Gardner et al. v. Town of Cameron et al. (N. Y.), 131 N. Y. S. 894.

Per Diem Fee and Expenses of an Inspection Trip Do not Constitute a Fraud in the Sale of Material to a Town.—A contract between a town and a steam roller company for the lease of such a roller is not fraudulent because the representative of the roller company, in negotiating the contract, paid the per diem fee of the members of the town board to attend a special meeting to authorize the contract and the expenses of the superintendent of highways and the town clerk on a trip to examine the roller.—Gardner et al. v. Town of Comeron et al. (N. Y.), 131 N. Y. S. 894.

Town May Not Evade Law Forbidding Purchase of Machinery by Leasing Under a Definite Time Contract.—A contract between a steam roller company and a town, whereby the town was to have

possession of a steam roller and to pay a rental of $10 per day for 64 days each each year for five years, at the end of which time it was to have the right to buy the roller for $1, though called a "lease," was a "sale," considering that all the negotiations between the roller company and the town were for a sale and the life of the roller was many times the period of five years, and hence was invalid under a highway law, providing that a town may, out of its own funds, purchase a roller, for which purpose the town board cannot pay more than $500 a year without submitting the matter to a vote, and that the town superintendent, where a town does not own a steam roller, may rent one at a rental not exceeding $10 per day for each day such roller is actually used.—Gardner et al. v. Town of Cameron et al. (N. Y.), 131 N. Y. S. 894.

Franchise Providing for Purchase at the End of Ten Years, Allows of Purchase at Any Time After That Period.—Where a borough ordinance, giving a franchise to enter on the streets to supply water to the borough and its inhabitants, provides that the borough shall have the option, ,before all other persons or corporations, to purchase the plant of the grantee of the franchise at the end of 10 years, as provided by the existing laws of the state, and, if no purchase is made at the end of 10 years, the ordinance shall remain in full force until the waterworks are purchased by the borough, the borough has the right to acquire the water plant on the terms provided at any time after 10 years, instead of at any time after 20 years as fixed in the statutes.—New Cumberland Borough v. Riverton Consolidated Water Co. et al. (Pa.), 81 A. R. 548.

City Not Obliged to Construct Sewers, But Must Maintain Them After Construction.—While a municipality is not bound to construct sewers and it is not liable for damages occasioned by the lack of them, yet where it either constructs sewers or adopts a private one it is liable for damages occasioned by its failure to keep them in proper repair.—City of Maysville v. Brooks (Ky.), 140 S. W. R. 665.

City Liable for Bad Condition of Dumping Ground.—A city authorized to maintain a dumping ground is liable for damages to adjoining owners, caused by its maintenance as a nuisance.—City of Haskell v. Webb (Tex.), 140 S. W. R. 127.

Refusal to Accept Material Specified in Bid Releases Contractor From Obligation to Enter Into a Contract.—A contractor made a bid for sewer construction, offering to supply steel for concrete reinforcement known as "Calumet steel bars" at a specified price per pound. The contractor executed a bond to enter into a contract if his bid was accepted. The bid was accepted, but the sewerage commissioners, not being familiar with Calumet steel bars, thereafter refused to accept such bars or to permit them to be used. Held, that the contractor's bid was based on the use of the bars named, and that, on the commissioners' refusal to permit their use, there was no acceptance of the bid, so as to entitle the commissioners to sue on the contractor's bond for his refusal to enter into the contract.—Commissioners of Sewerage of Louisville v. National Surety Co. (Ky.), 140 S. W. R. 62.

City Not Relieved From Liability by Letting Repair Work to an Independent Contractor.—A municipality cannot relieve itself from the duty to keep its streets in proper repair by transferring it to an independent contractor, and it will be responsible for the acts of a contractor if the matter involved in his contract is one of absolute duty owed by the city to an individual, or if the work is intrinsically dangerous, or if, even when properly done, it creates a nuisance, so that a municipality which authorizes the performance of work which necessarily renders the streets dangerous is liable for injuries due to the absence of barriers, lights, and other precautions for safety, but it will not be liable for acts of the contractor where the injury is through some negligence of the contractor in a matter in which the city owes no duty to the person injured.—Bailey v. City of Winston (N. C.), 72 S. E. R. 966.

City Not Relieved From Liability to Pay Price of Improvements, by Notice to the Contrary.—A city engineer having filed his estimate of the total cost of certain public work, the board of public works after finding that the special benefits on property within the assessment district and the benefits to the city would be equal to the estimated cost of the improvement ordered it done, and sent out a notice to bidders, declaring that the city would not be liable for any sum due from the properties or the owners, or for the payment of any bond,, or certificates issued to the contractor in payment for the work, except for such moneys as were actually received by the city from the assessments for the improvement. Held that such notice did not relieve the city from liability to the contractor for that part of the price for which the board failed to provide either assessment bonds or city funds.—City of Indianapolis v. American Construction Co. (Ind.), 96 N. E. R. 608.

Culverts or Drains in Natural Flow Line May Not Be Obstructed.

It was decided in a recent case in equity in Pennsylvania that, while a municipality is not responsible for the natural flow, yet if more water is thrown upon private land than the watercourse would contain, an owner is entitled to redress.

In the case in question the defendants, G. A. Buch and H. R. Gibbel, owned land which was in the natural water course of flood water from one of the turnpikes of the

village of Liberty. The flood water flowed down on the side of the turnpike opposite to the defendants' property, and the village and the Conestoga Traction Company had jointly placed a line of tile culvert to conduct the water across the pike when the grade of the roadway was raised so as to prevent the natural flow. The defendants thereupon began to fill up their lots and also the drain or water course, which runs across them, with loads of dirt and closed or threatened to close the openings of the terra cotta pipes. Whether or not they had the legal right to close up these pipes and the drain or natural water course is the question which was decided.

It was held from previous decisions that a person who builds a house in a ravine is bound to sustain any injuries which may occur from the natural flow of water into that ravine, and he is not bound for anything further than that. If, by any means a larger quantity of water is thrown upon him by the defendant's act than the natural flow of the watershed would contain and injury results thereby, without fault of plaintiffs, then they may recover compensation for whatever damage they have sustained by reason of this increase of water flow, taking it together with the ordinary water flow. A municipal corporation is liable for changing by the digging of ditches for that purpose the natural course of the water collecting on its streets and thereby throwing it on the land of a private owner.

But with those questions fully determined, another one arose which was the serious point of controversy in this case. In Reilly vs. Stephenson, 222 Pa. 252, it was decided as follows:

Some things, of course, he may not do. He may not proceed negligently so as to do unnecessary damage to others. But so far as he acts upon his right to protect his enjoyment of his own property any incidental loss to his neighbor is damage without injury. It is clearly settled, however, first, that he may not obstruct a natural channel for the flow of water or a channel that has acquired the character of an easement; and, secondly, he may not gather surface water into a body and discharge it on the adjoining land. His right is to shut out the invading water as a common enemy for the protection of his own land. If then there was a natural channel or water course over the defendant's lots—and it was found that this was the course for the water for a long series of years—had the defendants any right to fill up the lots so as to obstruct the pipes which carry the water to it? In Scranton City's Appeal, 121 Pa. 97, it appears that the plaintiff's lot was located upon the line of a natural water course of surface drainage; that, for some distance above the lot the line was marked by a ravine in which a small stream formerly flowed, kept alive by springs which afterward failed, but that for fifteen years the surface water had run into this ravine, usually a small stream occasionally dry and in rains a torrent. The city constructed along a street a culvert for this water to go through, and the court said that it was apparent that if no culvert had been built the ravine would have continued open and all the water that came into it would have flowed through it, and in time of flood would have been precipitated upon the plaintiff's land without restriction. A bill was filed against the city, and the court held that a court of equity would not restrain the municipality from the reconstruction and enlargement of the culvert across the street upon the allegation of a property owner that the proposed work would cause injury to his lot by the increased force and volume of water cast upon it, and the bill was thereupon dismissed at the costs of the plaintiff.

The only difference in the present case was that here the lot holder was endeavoring to close up the drains which carried the water accustomed formerly to flow over and along the turnpike, and the borough had filed a bill to prevent interference with those drains. It may be that, by reason of the opening of streets and the laying of cement gutters, a larger quantity of water had come through the pipes upon those lots than before flowed upon and over them. That question, however, did not seem to arise in this proceeding. If this part of the defendants' contention was true the borough might perhaps have been restricted to the amount which formerly drained over the land at the place or an action of damages might have been maintained for any injury which the defendants had received by reason of an increased flow of water upon their land. If, however, there was a natural channel or water course over the defendants' land and the water from the east side for a long period of time flowed through it, and the water of the west side at times also flowed to the same place, it made no difference to the defendants whether the water flowed upon the surface or through pipes, so long as the amount conducted along and across the turnpike through the pipes was that which would have ordinarily flowed to this point had no pipes been placed under the turnpike and pavement by the borough in order to so conduct the water.

It was therefore decided that the defendants had no right to complain on that account nor had they any right to obstruct the pipes. It was further held that as the pipes to conduct the water across the roadway had been lawfully placed and as the defendants were obstructing them and interfering with the flowage of the water, that an injunction should be issued restraining them from so doing. C. P. Lancaster Co. in equity, Docket No. 5, page 269.

Road Progress.—Effect of Good Roads.—Grooved Rails for Los Angeles.—Street Improvements in Portland.—Road Asphalt in Birmingham.

Recent Progress in the Good Roads Cause.
(Continued from p. 53, January number.)

OKLAHOMA.

The good roads law in Oklahoma was adopted in 1911. Sidney Suggs is state highway commissioner, Oklahoma City, and apparently his funds are derived from an annual state tax on automobiles of $1 each. There are 43,554 miles of roads in the State, with no reports from which to estimate the mileage of improved roads. Several counties are bonding themselves to raise funds for good roads, one for $1,250,000. The State will doubtless invest over a million dollars in good roads in the near future. The county roads are in charge of boards of county commissioners and a county surveyor. Local roads are under a township board of three members, who divide the township into suitable districts and appoint a road overseer for each.

Oklahoma has a population of 1,657,155, which increased nearly 110 per cent. in the last census decade. Its 77 counties range in population from 5,000 to 85,000.

OREGON.

Oregon has as yet done nothing toward state construction of roads. John H. Lewis, Salem, is state engineer. In 1904, according to statistics collected by the U. S. Office of Public Roads, the State had 34,258 miles of road, of which 2,235 had been surfaced with gravel, 209 miles with stone and 145 with plank. The road expenditures for the year were $796,376. Expenditures had increased in 1907 to $997,701, of which $182,697 were for bridges. One county has voted to bond itself for $1,500,000 for constructing roads, and the validity of the bonds is now under consideration by the Supreme Court. Macadam roads built under the direction of the U. S. Office of Public Roads cost from $5,100 to $6,600 per mile.

The roads are in charge of county courts of two commissioners each, who divide the county into districts and appoint a supervisor for each district.

Oregon has a population of 672,765, which increased nearly 65 per cent. in the last census decade. Its 34 counties range in population from 2,000 to 40,000, with one county of 226,000 population.

PENNSYLVANIA.

The roads of Pennsylvania are in charge of E. M. Bigelow, state highway commissioner, Harrisburg. The first state aid law was passed in 1903 and, including 1910, $9,920,489 had been spent under that law and its amendments. The appropriations for 1911 for construction and maintenance were $4,000,000.

The law as amended in 1911 puts the department in charge of the state highway commissioner and two deputies, all appointed by the Governor, and one a competent civil engineer, and a chief engineer, also appointed by the Governor. The commissioner appoints assistant engineers, superintendents, draftsmen, clerks, stenographers and bookkeepers. He can purchase materials, tools, horses, etc., as necessary. Highways designated are taken over from the counties and townships as conditions permit and improved at the expense of the State. Two hundred and ninety-six routes, amounting to about 8,000 miles, are described and defined in the act. Roads in boroughs or incorporated towns are only taken over by the State in case there would otherwise be a break in the line of improvement of the route. Half the cost of maintenance by the State must be paid by the towns or boroughs on parts of roads within their borders, unless they have heretofore been paved with other than telford waterbound macadam, in which case they must be maintained by the corporation according to state specifications. The commissioner improves the state roads according to specifications adopted by him, and they are paid for by the State upon his certificate. Maintenance contracts may be let. Construction must be by contract. All contracts must be approved by the Governor. Signs and guide-posts on state highways are provided for. The state highway commissioner has control of the use of highways by railroads, street railroads, water, gas or conduit lines, or wire lines and poles, also of methods of use of roads by vehicles. The

materials named for use in state roads are macadam, telford or other stone road, brick, gravel, cinder, oyster shells, or other good materials or combinations of materials. Width must be at least twelve feet and length at least one-half mile. Surveys of all the roads in the State, compilation of road statistics, establishment of standards of construction suitable for the various conditions in the State, consultation with local authorities in charge of highways and bridges, promotion of road improvement, issue of bulletins, publication of county road maps, are some of the duties of the state highway commissioner. Counties and townships by process prescribed can secure state aid in construction and maintenance of roads not included in the list of state roads, the State paying not more than 50 per cent. of the cost of construction and maintenance, the county and the township each to pay 25 per cent. of cost of construction and the township 50 per cent. of maintenance cost, or in such proportions as county and township may agree upon or accept. The township must levy tax enough each year to pay its share of annual cost to the State in cash. The state highway commissioner lets the contracts for the improvement of state aid roads, and they are thereafter under his control. Property owners may petition for state aid roads and owners of a majority of the property in a township can prevent the improvement by proper remonstrance. State aid funds are apportioned to the counties in proportion to mileage of roads, and if not used by a certain time are reapportioned to counties asking for more roads than their first share of the State appropriations would pay for. Counties, townships, boroughs and towns can bid for construction of state aid roads and have same privileges and duties as other bidders. The State pays the contractors and the counties and townships pay the State on requisition of the highway commissioner. The act appropriated $3,000,000 for construction, maintenance and repair of state highways and maintenance and repair of state aid highways under its provisions, and $1,000,000 for the State's share of state aid highways, to be available until expended.

Another act takes the first step toward the amendment of the State Constitution so that the State can issue $50,000,000 in bonds to raise funds for road construction. If the program laid down is followed the first of this money will be available in 1915.

Another act provides for levying of road taxes in cash in townships of the second class and for the payment to such townships by the State of half as much as the township tax raises, provided that no township shall receive more per year than $20 per mile of township road, and that the limit of the appropriation is not exceeded, viz: $500,000, to be distributed over the years 1912 and 1913.

The State has 99,041 miles of road, of which 3,365 miles have been improved, 784 of which had State aid. These state aid roads were paid for, part of them, 75 per cent. by the State and 12.5 per cent. each by county and township, and part two-thirds by the State and one-third each by county and township.

The average cost of macadam roads in Pennsylvania is $11,646 a mile; of bituminous macadam, $15,649, and of brick, $13,320.

Five contracts, amounting to about $500,000, have been made under the new law. The commissioner has received 29 applications for state aid on 64 miles of road.

The income from automobile licenses approximates $500,000 a year.

County roads are in charge of a board of three county commissioners and some counties employ county engineers. Township roads are under boards of three road supervisors each, who divide their township into districts of not less than 5 miles length of road and appoint a roadmaster for each district.

Pennsylvania has a population of 7,665,111, which is increasing about 20 per cent. per decade. Its 67 counties range in population from 8,000 to 260,000, with one county of 1,000,000 and one of 1,500,000 population.

The Effect of Good Roads.*

BY J. H. HAWLEY, SECRETARY GULF COAST GOOD ROADS ASSOCIATION.

The territory of Texas, of which Fayette county forms the center, is perhaps the most productive in a diversified way of any like area within the confines of this imperial state. You have here, as in nearly every other county in Texas, fine railroad facilities, but you lack, as is also the case in other counties in Texas, good, hard-surfaced highways upon which the farmer and producer, both in manufacturing and agriculture, can cheaply and without regard to weather conditions deliver his products to and take away his purchases from the various towns and villages which make up the condensed population of the county.

Good roads cost money, and this should not be overlooked in making the initial calculations. You must figure the cost of your roads against what the present condition of your roads cost you, to see where you come out, and then you can determine what outlay is essential to put your section of the county, if that is your final determination, up out of the mud and bring your town of Roundtop and its surrounding tributary country in active and cheap contact with your railroad station and your court house town. Generally a precinct can supply itself adequately with hard-surfaced improved high-

*Abstract of paper before a roads mass meeting at LaGrange, Texas.

ways by the construction of from thirty to thirty-five miles, if due regard is paid to the location of your population.

The proper course can be reached by the employment of a highway engineer, who must be, first, a locating engineer, a man who understands establishing a route or line of travel, considering all the factors involved, that is to say, gradients and water courses, as well as drainage. Economy of construction is the first consideratаion after you have established lines of least resistance and your engineer must also be a practical road builder, a man who knows how to draw up specifications involving efficiency and economy, and who knows how to utilize the materials which he may find suitable for the purpose close at hand and who knows how to prepare a contract or assist the legal adviser of the precinct in doing so. Such a man as that is worth his hire, every dollar of it, because he prevents you from getting into bad contracts and guarantees you against bad work and the loss of money, which too frequently is to be found the case in such enterprises.

No one will question the integrity of your county commissions, but they know, as well as you do, that they are not highway engineers and that their knowledge of road building must be of the most superficial character, and therefore not to be considered for one moment where the expenditure of any large sum of money is intended. In point of fact, without derogation from the county commissions of the various counties of the State, it should be clearly understood that the automatic 15 cents per $100 dollars authorized by the constitution for the road and bridge fund, as well as the 15 cents that is sometimes authorized by vote of taxpayers for the same character of work, making a total of 30 cents on the $100, is the most abused fund handled through the county treasurer's office. It comes nearer being wasted than it does accomplishing the purpose for which it is collected. It can not be, without the advice of a first-class engineer, wisely spent. No man who does not know the business thoroughly can spend money wisely in that business, and where you have such a large assessed valuation as is shown by the statistics of 1910, and I presume, considering your county in relation to other counties of the State on the same basis, that the assessment for 1911 must be at least two or three millions of dollars more for your entire county, you can readily understand the importance of having engineer's advice to handle so large a sum of money in road maintenance and repair as will often arise from the 15 cents automatically allowed by the constitution, giving you in the county $30,000 a year, and if you add the 15 cents that is authorized by a majority vote of the taxpayers, you have under those two tax rates $60,000 a year with which to take care of the roads of the county.

The average distance of the farm from the railroad station throughout Texas is about ten miles. Of course there are a great many which are further away, and, when you are informed firmly and solemnly that when you can pass over your roads at all, the cost of handling a ton of freight over them is nearly forty cents per mile, as against the actual cost of haul on a good road of less than 10 cents a ton per mile, some appreciation can be had of the difference between a good road and a bad one. If the difference in the cost of haul was all, it would be merely a matter of money. Of course, it doesn't make any difference to you gentlemen in the country who are engaged in agricultural pursuits, about the serious loss you sustain in money, because you would rather evidently continue to lose the difference in money and enjoy the difficulties and troubles and delays in your bad roads than to vote a bond issue and pay annually a fixed sum for permanent and substantial relief from the incubus of bad roads, but forget if you can the difference in cost between the good and bad road in money and consider the difficulties surrounding your family.

There has been a great deal said in the papers recently regarding National aid for the construction of roads in the States. Do not listen for a moment to such specious arguments. The National government can not aid in the construction of roads without an amendment to the constitution of the United States. President Monroe said so, and President Jackson, in his message of 1828, said so, and since he issued his veto, no attempt has been made to get highway legislation through the congress. I have a letter from a cabinet officer, in which he specifically states that the administration does not favor National highway legislation, appropriating money to build highways in the States, and the recent convention at Richmond, Va., split asunder on the subject. The American Association for Highway Improvement of which the Gulf Coast Good Roads association is a member, takes the high ground that constitutional objections exist to National aid and the people of the various States must rely upon themselves for the construction of "good roads." You know full well that the constitution of the State of Texas, article 3, sections 43 and 50, specifically provide that the State of Texas can not issue bonds nor lend its credit to any such enterprises. State aid is therefore not to be expected under any circumstances. Under the most favorable conditions, the advocates of National aid make it a condition precedent that the sum of money appropriated by the National government shall be equally appropriated by the State. As we are denied the privilege of extending any credit, issuing any bonds, or lending any

money, our chance in Texas for getting National aid, even if it was constitutional, is so slim that it is absurd to think of it for a moment. If you want good roads in your precinct or county, build them yourselves.

Grooved Rails for Paved Streets in Los Angeles.

As a result of continued agitation against the use of center bearing or "T" rails upon paved streets, action has been taken by the board of public works of Los Angeles, Cal., to enforce the use of grooved rails. The objection raised to the "T" rail was the fact that the granite blocks or bricks laid next to it in order to form a groove for the car wheel flange, became rough and were forced out of place by the heavy traffic.

The grooved rail adopted was what is known as section No. 292 of the Pennsylvania Steel Co. It is of the girder type, 7 inches in height, over all, and 5⅝ inches in width across the head and lip forming the groove. The lip or side of the rail, which forms the wall of the groove opposite from that on which the wheel runs, is ⅜ of an inch lower than the other. It is estimated by engineers that the grinding of the wheels on the rail will wear that part of the rail down even with the other side in a few years. For this reason the rail is beveled on the outside so that when it is laid the top will be slightly above the pavement.

The groove of the rails is of such a shape as to make them self-cleaning. Dirt or other material which lodges in the groove is supposed to be forced out by the flange of the car wheel passing through it.

In some of the far northern cities of the country, such as St. Paul and Minneapolis, the chief argument used against the girder rail is that ice, snow and frozen dirt clog the groove in cold weather. This, of course, does not apply to Southern California.

Following is a list of cities in which the grooved rail is being used on paved streets:

Atlanta, Ga.; Baltimore, Md.; Buffalo, N. Y.; Brooklyn, N. Y.; Boston, Mass.; Cambridge, Mass; Camden, N. J.; Chicago, Ill.; Cincinnati, O.; Cleveland, O.; Elizabeth, N. J.; Fall River, Mass.; Harrisburg, Pa.; Kansas City, Mo.; Lowell, Mass.; McKeesport, Pa.; Memphis, Tenn.; New York, Manhattan, Bronx and Queens Boroughs; New Bedford, Mass.; Norfolk, Va.; Omaha, Neb.; Philadelphia, Pa.; Pittsburg, Pa.; Portland, Me.; Portland, Ore.; Richmond, Va; St. Louis, Mo.; San Francisco, Cal.; Springfield, Mass.; Troy, N. Y.; Washington, D. C.; Yonkers, N. Y.

Some of the larger cities which still have the old style of "T" rails on paved streets are Duluth, Minn.; Minneapolis, Minn.; New Haven, Conn.; Milwaukee, Wis.; Rochester, N. Y., and St. Paul, Minn.

Street Improvements in Portland.

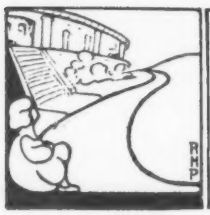
According to a recent report of Mayor Rushlight, of Portland, Ore., $7,000,000 in street improvements have been laid under the direction of the city engineer during the year. One hundred miles of hard-surface pavements have been laid and other streets improved amounting to 75 miles. He asserts that a substantial reduction in the cost of street improvements has been made and predicts that under the competitive method recently put into effect, a more sweeping reduction in the cost of such improvements will result. He requested the city engineer to devise some plan for roughening the surface of the pavements so that they will provide a firm foothold for animals. The establishment of a municipal street repair plant is urged, which he believes will result in a big saving of expense to the city.

Road Asphalt in Birmingham, Ala.

Birmingham, Alabama, in common with a great many cities of the South, has a number of streets which are constructed with gravel. The constant traffic on these streets has made a solid foundation, but through the disintegration of the surface, the city had the dust nuisance to contend with in the summer and the reavy mud in winter. In order to eliminate this condition it was decided to use Texaco Road Asphalt on the surface of the roads.

Tuscaloosa Avenue is one of the most heavily travelled streets in the city. The traffic on this avenue includes not only a large number of automobiles daily but a considerable amount of heavy trucking, so that conditions are about as severe as it would be possible to find in this part of the country. This condition is further complicated by a double set of car tracks and switches running through the center of the street. The specifications call for the surfacing to be carried right to the edge of the rails, the whole proposition representing a very severe test.

The method of building this road was a little unusual. After the sugbrade had been fiuished to conform to the required grade of the road, ten inches below; the paving surface about 720 feet in length and 35 feet in width was laid with 8 inches of 2½ and 1½ inch stones. This was filled with screenings and rolled to a surface with a ten ton roller, thus leaving a solid foundation. After this was accomplished the road was ready for a wearing surface of 2 inches of 1½ inch stone, rolled again and filled with Texaco Road Asphalt applied at the rate of approximately two gallons to the square yard, poured by hand with the ordinary pouring can. One-quarter inch screenings were sprinkled over the surface, swept into the voids, rolled and finished off with a ten ton roller. The street was then open for traffic and up to the present time is in excellent condition.



ORGANIZATIONS & INDIVIDUALS

Standardizing Specifications.—Indiana Sanitary Association.—Chicago City Club.—Technical Schools.—Technical Associations.—Calendar.—Personal Notes.

Association for Standardizing Paving Specifications.

The third convention of the Association for Standardizing Paving Specifications was held in New Orleans the week of January 8, the convention being the guests of Capt. W. J. Hardee, city engineer, and the city of New Orleans. Trains were so seriously delayed that the opening session, including the address of welcome from Mayor Behrman, the responses by N. P. Lewis and President Tillson and the appointment of committees, was not called until late Monday afternoon.

About 24 cities were represented in all by about 55 delegates, and there were about 30 associate members and visitors from cities not members of the association.

The statement was made by the president that committees of five each had been at work during the year. But they had not presented formal reports and all the members of the committees were not present, so the vacancies were filled and in some cases the numbers increased by appointments made by the president. But four of the eight chairmen who acted during the year were present. The new committees varied in membership from five to eight and either two or three members had acted during the year on each committee except that on wooden blocks, of which only one member survived. Upon appointment of the committees the convention adjourned until Thursday to give the committees an opportunity to prepare reports.

Each committee was given a room and the committee meetings were much more open and informal than at either of the preceding conventions. The committee rooms were busy places during much of the time on Tuesday, Wednesday and Thursday morning and the results met with far less criticism than those of either of the preceding conventions, largely because the methods of conducting the meetings were far less open to criticism. The loss of time of the convention was not so serious as it might have been, since nearly every delegate present was a member of a committee.

Most of the committee reports were presented at the Thursday sessions, but one report and the election of officers and other business being left for a meeting Friday night, at which there were a number of vacancies in the representations of cities. The specifications adopted at previous conventions were taken as the basis of work and the new specifications presented by the committee and adopted with little modification by the association differ in but few respects from the earlier work of the society. Statement of some of the changes follows.

The objects of the committee on wooden blocks were stated to be to prevent the absorption of water at the bottom of the blocks and to give greater latitude for selection of preservative. The minimum number of annual rings in yellow pine timber was changed to 6 per inch, averaging not less than 8. Sizes of blocks were modified somewhat, and length of blocks 3 inches deep was limited to 8 inches. The specification for heavy oil for treatment of blocks was slightly modified, the limit of specific gravity remaining 1.10 and 1.14 at 38 degrees C. The alternative specification for lighter oil for treatment calls for specific gravity at 38 degrees C. between 1.03 and 1.08, with some increase in percentage of distillates. The temperature of treatment of blocks is fixed at 240 degrees F. and amount to be injected is reduced to 18 lbs. per cubic foot, except for gum, which is fixed at 22 lbs. Variations in specification between 16 and 20 lbs. are permitted to suit local conditions. An alternative to the 1-in. sand cushion of the former specification is a mortar cushion made of 1 part Portland cement and 4 sand, mixed, laid dry, sprinkled lightly and the blocks set in it. A note is added for special conditions allowing instead of the cushion a bituminous coating on dry concrete in which the blocks are set while it is still hot. Bituminous filler for joints is provided except that over a bituminous cushion sand filler may be used.

The committee on stone block made few changes, adding preference for blocks of over 1,600 lbs. crushing strength, making sand cushion 2 in. and changing details of

tests of asphaltic filler and method of applying.

The committee on brick added a specification for abrasion loss and process of determination which is practically the same as that adopted by the Am. Soc. Mun. Imp., with the maximum loss for first-class street fixed at 22, but a note permitting 25 or even 28 per cent. for medium and light traffic streets. Sand cushion is made 1½ in. after rolling. Bituminous filler specification is also modified to agree with that for stone blocks.

The committee on cement, concrete and concrete pavements slightly modified range of sizes for fine aggregate, fixed maximum time between laying of bottom and top coats at 45 minutes, stops laying when materials or air are below 32 degrees temperature. The principal additions were an alternative provision for preparation of concrete for a bituminous surface and for what may be termed a contraction rather than an expansion joint, being a line of creosoted soft wood timber set at right angles to the street line each 50 feet of its length, the wood being set with fibres vertical.

The committee on bituminous concrete retains the specification for a one-layer pavement of last year and adds one for a two-course pavement which it deems safe from suit for infringement. The former specification is modified, giving more detail as to limits of penetration of asphaltic cement for various weights of traffic and characteristics of coal tar cement. The latter calls for a binder course of 1-in. to 2 or 2½-in. stone, one stone deep without or with bitumen by penetration or mixing method and a wearing surface of 0.1-in. to 200-mesh fine aggregate and 25 per cent. ½ or ⅝-in. to ¼ or ⅜-in. crushed stone, to which is added 8 to 10 per cent. of bituminous cement, mixture and laying being as prescribed for the former specification.

The committee on macadam expressed itself as opposed to a water-bound macadam for a permanent pavement on a city street and submitted a specification for a bituminous macadam pavement providing for a macadam base of coarse stone well filled with fines, a second layer of medium size stone well filled with screenings and a top surface to be filled with asphaltic material or refined coal tar of specifications given and laid carefully as provided, and finished with a squeegee coat and screenings. The committee report was adopted with but little change, which doubtless carries the condemnation of water-bound macadam.

The report of the committee on bonds and guarantees was adopted although some delegates thought it contained too many blanks which it was the province of the association to fill. It did not differ very materially from last year's report.

The principal change in the asphalt specification was to add a clause to provide for the admission of good artificial asphalts of low ductility and high penetration, which reads, "Asphaltic cement not varying more than 125 in penetration between 32 and 115 degrees F., shall have a ductility of not less than 6 cm. at 77 degrees and not less than 2 cm. at 32 degrees F."

The officers elected were: W. J. Hardee, city engineer of New Orleans, president: N. P. Lewis, chief engineer of board of estimate and apportionment of New York, Geo. W. Tonson, director of public service of Toledo, N. E. Murray, superintendent of sidewalks of Chicago, and L. R. Ash, city engineer of Kansas City, vice-presidents; J. B. Hittell, chief engineer of streets of Chicago, secretary and treasurer. Pittsburgh was chosen as the next place of meeting, the time being left to the president and the executive committee.

A theater party on Tuesday night, a luncheon and automobile trip for the ladies on Wednesday, a banquet on Thursday night, a river trip on Friday and a trip about the new water and sewerage systems of the city on Saturday made the stay of the delegates and their friends most agreeable and instructive.

The Indiana Sanitary and Water Supply Association.

The fifth annual meeting of the Indiana Sanitary and Water Supply Association will be held in Indianapolis February 15 and 16. The program includes such men as Prof. Halford Erickson, of the Wisconsin Railway Commission; Dr. George B. Young, commissioner of health of Chicago; T. C. Phillips, of the department of water waste survey, Chicago; R. L. Sackett, professor sanitary engineering, Purdue University; Geo. E. Kessler, landscape engineer; Geo. W. Fuller, consulting engineer, New York City; Prof. McGee, of the National Department of Agriculture, Washington, D. C.; H. E. Barnard, Indianapolis, State Food and Drug Commissioner; Dow R. Gwinn, president Terre Haute Water Works Company; E. L. Loomis, superintendent water department, Valparaiso; J. F. O'Donnell, Indianapolis Water Company; Richard Lieber, member Indianapolis Commission on Fire Insurance; J. F. Newell, chief of the U. S. Hydrographic Survey, Washington, D. C.; Dr. J. N. Hurty, secretary Indiana State Board of Health, and others.

Among the papers to be given are the following: "Fire Waste and Fire Prevention"; "Latest Development in Water Purification Methods"; "Management of Water Plants in the Smaller Cities"; "The Wisconsin Public Utilities Commission"; "The Value to a Community of the Purification of Its Streams"; "Pitometer Surveys and Other Rigid Inspections"; "The Report on

the Condition of White River, with Suggestions on Sewage Disposal."

W. F. King, M. D., Indianapolis, Ind., is secretary of the association.

The City Club of Chicago.

The City Club of Chicago was formally installed in its new building on 315 Plymouth Court, on January 8th. In connection with the opening a civic exhibit by the civic committees of the City Club was maintained from January 8 to 13, inclusive. The exhibits included matter relative to financial control; municipal publicity and statistics; education and recreation; charities and public health; elections, civil service and public safety; city planning, municipal art, traffic, and lighting.

The City Club was founded in 1903 by a small group of public-spirited citizens. It has grown steadily. Its main purpose is to bring together for conference and discussion those who are interested in civic problems and civic improvements, who wish to understand municipal questions and to promote good municipal administration. The club is not in partisan politics and takes no formal action as a club. It is organized in such a way, however, that every set of questions can be and is studied by a committee, and the committees, with the approval of the directors, are free to make suggestions or offer aid to the various municipal departments.

Technical Schools.

Prof. Filibert Roth, of the forestry school of the University of Michigan, has been selected as the head of the forestry department of the New York State College of Agriculture at Cornell University. Professor Roth has been engaged in important government forestry work during recent years.

The Pennsylvania Railroad Company has placed a dynamometer car at the disposal of the Pennsylvania State College. The drawbar capacity of this car is twenty-eight thousand pounds. It is quite a complete piece of apparatus, costing originally about $30,000. Some time ago, the same railroad company placed at the disposal of the same college, an eight-wheel locomotive. These two pieces of equipment serve an excellent purpose for experimental and instructional work.

The Industrial Bureau and School Board of Winnipeg, Canada, have taken steps to inaugurate a series of technical lectures to school boys and tradesmen of that city. Briefly the plan is to have experienced and qualified men in different trades address the boys of the fifth, sixth and seventh grades an hour and a half each week at the schools and to have these instructive talks prepared in advance and published in pamphlet form, in order that the boys may carry the message home to their parents. The other feature of the plan is that the Bureau will get expert men in different trades to come to Winnipeg and address factory men on different technical subjects. W. J. Bulman, of the Industrial Bureau, is chairman of the special committee in charge of the work

H. M. Byllesby, president of the H. M. Byllesby Company, gave an address before the students and faculty of the College of Engineering of the University of Illinois on Thursday, January 18. His subject was "Organization in Engineering." The occasion for the address was an assembly of the College of Engineering. Twelve hundred engineering students and one hundred members of the faculty were in attendance. The members of the Illinois Society of Engineers and Surveyors, in convention at the University, were the special guests at the assembly. Brief addresses were also made by J. G. Gabelman, president of the Illinois Society of Engineers and Surveyors; by W. L. Abbott and F. L. Hatch, trustees of the University of Illinois, and by Dr. W. F. M. Goss, dean of the College of Engineering.

In connection with the graduate course in highway engineering at Columbia University, the following illustrated lectures were given during the month of January: "Problems of the Sales Departments of Road-Material Manufacturing Companies," by Charles P. Price, manager, The American Tar Company, Boston; The Organization of the Engineering Forces of the State Roads Commission of Maryland, Major Walter W. Crosby, Chief Engineer, Maryland State Roads Commission.

Technical Associations.

At the annual meeting of the Civil Engineers' Club of Cincinnati, Prof John P. Fait, University of Cincinnati, was elected president; Prof. Herman Schneider, University of Cincinnati, vice president, and E. A. Gast, secretary and treasurer.

The third annual meeting of the Indiana Public Improvement Association was held at the Hotel Denison, Indianapolis, Ind., on January 11th and 12th. The association was organized in 1909 for the purpose of furthering of public matters generally. The following officers were elected: President, Fred Cunningham, Linton, Ind.; vice president, John Holloran, Indianapolis, Ind.; secretary-treasurer, Alfred H. Barnes, Logansport, Ind.

At a regular meeting of the Brooklyn Engineers' Club, held on January 11th, Frederick L. Cranford presented a paper on "The Relation of the Business Man and Engineer to the Present Industrial Problem."

At a regular meeting of the New York Electrical Society held on January 25th, E. P. Edwards, of the General Electric Company, Schenectady, N. Y., presented a paper on "Electricity as a Factor in Progressive Agriculture."

The thirty-second annual convention of the American Water Works Association will

be held at Louisville, Ky., June 3d to 8th. After February 1, 1912, the address of the secretary of the association will be J. M. Diven, secretary, 271 River street, Troy, N. Y.

The Mayors' Society of New Jersey was organized at a meeting held January 13th in Elizabeth, N. J. The following officers were elected: Frederick W. Donnelly, mayor of Trenton, President; A. F. Pierson, Morristown, secretary; A. B. Seymour, of Orange, treasurer.

At the annual meeting of the New England Water Works Association held in Boston on January 10, the following officers were elected: President, George W. Bachelder; secretary, Willard Kent; treasurer, Lewis M. Bancroft.

The following officers have been elected by the Western Society of Engineers: President, W. C. Armstrong (Engineer of Bridges, C. & N. W. Ry.); vice-presidents, A. Bement, G. T. Seely and E. C. Shankland; treasurer, A Reichmann; secretary, J. H. Warder.

The annual meeting of the American Society of Civil Engineers was held at the society house on January 17. The officers elected for the current year were: J. A. Ockerson, president; C. S. Churchill and C. D. Marx, vice presidents; J. M. Knap, treasurer; Lincoln Bush, T. Kennard Thompson, Emil Gerber, Wiliam Cain, E. C. Lewis and W. A. Cattell, directors. The new members of the nominating committee elected at the meeting are: Merritt H. Smith, H. P. Eddy, A. E. Kasti, J. F. Murray, A. F. Baldwin, J. F. Coleman and R. H. Thompson.

At the annual meeting of the St. Louis Engineers' Club, A. S. Langsdorf was elected president; John Hunter, first vice president; H. H. Humphrey, second vice president; W. W. Horner, secretary; W. E. Rolfe, treasurer, and E. A. Sweetser, librarian.

At the annual meeting of the American Society of Agricultural Engineers, in St. Paul on December 28, H. W. Riley, of Ithaca, N. Y., was elected president; J. B. Bartholomew, of Peoria, Ill., first vice president; W. Chase, second vice president; O. O. Reed, of Champaign, Ill., secretary, and J. L. Mowrey, of Minneapolis, Minn., treasurer.

The Des Moines Engineers' Club has elected the following officers for 1912: President, L. H. Stone, vice president, J. E. Van Liew; secretary-treasurer, F. R. Hubbard.

The thirty-second annual meeting of the Indiana Engineering Society was held in Indianapolis January 25-27. The following were among the papers presented: "Concrete Pavement for City Streets and County Roads," by J. H. Chubb, Chicago, Ill.; "The Vertical Posts of Bridges," by Prof. Albert Smith, Lafayette, Ind.; "The Foundation of the Cherry Street Bridge, Toledo, O.," by Willard A. Knapp, Lafayette, Ind.; "Bituminous Macadam Pavement" (printed on page 92 of this issue), by A. N. Johnston, State Highway Commissioner, Springfield, Ill.; "The Care, Maintenance and Construction of Country Roads," by Robert E. Gibbons, Terre Haute, Ind.; "A Pneumatic Street Cleaning Machine," by Charles A. Tripp, Indianapolis, Ind.; "Inspection and Cost Data in Relation to City Improvements," by F. O. Hodson, Gary, Ind.; "Oil Mixed Concrete," by Logan Waller Page, Washington, D. C.; "Bitumens Mixed With Concrete," by Prof. H. H. Schofield, Lafayette, Ind.; "Practical Concrete Construction," by DeWitt V. Moore, Indianapolis, Ind.; "The Failure of Dams," by Prof. R. L. Sackett, Lafayette, Ind.; "Filtration Plant Operation," by Harry E. Jordan, Indianapolis, Ind.; "Electrical Methods of Water Purification," by Prof. R. L. Sackett, Lafayette, Ind.; "Economic Features in Pumping and Power Plant," by Charles Brossman, Indianapolis, Ind.

Ornamental Street Lighting in Poughkeepsie.

Poughkeepsie, N. Y., has recently installed a combination ornamental lighting system, using the trolley poles to support the lamp arms.

The pole decided upon has an over-all length of 30 feet, with three successive diameters, 7-inch, 6-inch and 5-inch, and several ornamental collars and an ornamental base 19 inches in diameter. Each one of the four lamp arms is cast separately and then bolted to a semi-circular collar, two of which are bolted together around a small shoulder, which projects from the pole. The poles are set 6 feet in the ground, filled in with concrete, which runs inside of the pole through a hole purposely left in the casting, and then left for ten days before being subjected to any strain. The poles are painted green, with the exception of the ornamental collars and extremities of the arms, which are aluminum color. The equipment for each cluster consists of four 100-watt Mazda multiple lamps of the drawn wire type, on a 120-volt alternating current circuit; each lamp is pendant, enclosed in a 12-inch opal globe 13 feet from the ground. Some sand blasted globes were also used, but are being discarded on account of glare.

The system is similar in many ways to that contemplated for Dearborn street, Chicago, Ill.

Calendar of Technical Meetings.

Second Annual New York Cement Show.—Madison Square Garden, January 28-February 3. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

New England Association of Gas Engineers.—Annual meeting, Boston, Mass., February 14-15. N. W. Gifford, secretary, 26 Central street, East Boston, Mass.

Indiana Sanitary and Water Supply Association.—Fourth anual convention, Indianapolis, Ind., February 15-16. Dr. W. F. King, secretary, Indianapolis, Ind.

Iowa Engineering Society.—Annual meeting, Davenport, Ia., February 21-23. S. M. Woodward, secretary, Iowa City, Ia.

Fifth Annual Chicago Cement Show.—Coliseum, Chicago, Ill., February 21-28. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

National Brick Manufacturers' Association.—Annual convention, Chicago, Ill., March 6-9. T. A. Randall, secretary, Indianapolis, Ind.

International Brick and Clay Products Exposition.—Coliseum, Chicago, Ill., March 7-12. Office, 815 Chamber of Commerce Building, Chicago, Ill.

First Annual Kansas City Cement Show.—Convention Hall, March 14-21. J. P. Beck, general manager Cement Products Exhibition Co., 72 West Adams street, Chicago, Ill.

American Water Works Association.—Annual convention, Louisville, Ky., June 3-8. John M. Diven, 271 River street, Troy, N. Y.

Personal Notes.

Frank D. Mount has been appointed city engineer of Atlantic City, N. J.

John L. Kirk, for twenty-one years chief of the Bureau of Lighting, of Philadelphia, Pa., has resigned.

J. W. Barnett has been reappointed city engineer of Athens, Ga. He has held this position since 1890.

Henry F. Waige, formerly chief engineer of the Crichfield Coal Co., has been appointed city engineer of Cincinnati, O.

L. W. Rundlett, former city engineer of St. Paul, Minn., has been made commissioner of public works of Moose Jaw, Canada.

Thomas Wilson, former engineer of construction for Atlanta, Ga., has been appointed engineer of highways of Fulton county, Ga.

M. R. Watson has opened an office at 308 American National Bank building, Tampa, Fla., for the practice of general civil engineering.

Herbert W. Pierce has been appointed commissioner of public works of Rochester, N. Y. Edwin A. Fisher has been reappointed city engineer.

G. H. Herrold, M. W., Soc. of Eng., M. Am. Ry. Eng. Assoc., has opened an office in the Hackney building, St. Paul, for the general practice of engineering.

Gaylord C. Cummin has been named as city engineer of Dayton, O. He has recently been engaged on irrigation work in connection with the transcontinental railroads.

Frederick S. Parkhurst, Jr., has been reappointed city engineer of Niagara Falls, N. Y. Norman G. Ray has been appointed deputy city engineer, a newly created position.

W. T. Thompson, formerly general manager o fthe Iroquois Iron Works, Buffalo, N. Y., has been elected vice president and general manager of the Monarch Road Roller Co., Groton, N. Y.

C. F. Brown, Assoc. M. Am. Soc. C. E., and H. S. Kleinschmidt, Assoc. M. Am. Soc. C. E., have formed a partnership under the firm name of Brown & Kleinschmidt, for a general civil and consulting engineering practice, with offices at 1005 Newhouse building, Salt Lake City, Utah.

Frederick W. Ballard, manager of the engineering and construction department of the Sherwin-Williams Company and secretary of the Cleveland Engineering Society, was appointed by Mayor Baker of Cleveland as consulting engineer o' the $2,000,000 municipal electric light plant.

Charles E. Treman has resigned as superintendent of public works of the State of New York and Franklin W. Peck, of Syracuse, has been appointed to succeed him. Mr. Peck has been serving as assistant superintendent in charge of the middle division of the State canal system.

Peter F. Huntington has been appointed city engineer of Eveleth, Minn., and Edward F. Forrestal, superintendent of water works.

Charles U. Powell has been appointed assistant engineer of the Topographical Bureau of the Borough of Queens, New York City. He has been serving in that department since 1902.

John M. Diven, superintendent of water works at Charleston, S. C., has been appointed to a similar position with the city of Troy, N. Y. Mr. Diven is a native of New York state and was for a number of years connected with the water works of Elmira, becoming superintendent in 1883. He is secretary of the American Water Works Association.

James W. Synan, of Pittsfield, Mass., has been named by Governor Foss to fill the vacancy on the State Highway Commission caused by the resignation of Harold Parker.

George W. Fuller, consulting engineer, New York, has been retained by the city of Lincoln, Neb., to make recommendations for protection to the city water supply and changes and additions to the sewerage system.

George W. Jackson and E. A. Clark announce the formation of a consulting engineering firm with offices at 756 West Jackson boulevard, Chicago, and 228 West Forty-second street, New York. The new firm is entirely separate from George W. Jackson, Inc.

W. T. Wooley, formerly engineer of the Public Improvement Commission of Hoosick Falls, N. Y., has been appointed city engineer of Schenectady, N. Y.

The Bureau of Associated Geological Engineers, a firm of consulting experts on water supplies, bridge and dam foundations and other problems of municipal engineering, will hereafter maintain offices at 131 State street, Boston, and 331 Fourth avenue, Pittsburg, Pa. The Boston office will be under the management of Myron L. Fuller, formerly in charge of the water supply investigations in the Eastern United States for the United States Geological Survey.

Austin B. Fletcher, M. Am. Soc. C. E., State Highway Engineer of California, has announced the following appointments as division engineers in charge of preliminary surveys and construction: W. C. Howe, Assoc. M. Am. Soc. C. E., Sacramento, division No. 3; F. C. Sumner Willits, division No. 1; T. A. Bedford, M. Am. Soc. C. E., Redding, division No. 3; A. E. Loder, San Francisco, division No. 4; W. S. Caruthers, San Luis Obispo, division No. 5; J. B. Woodson, Fresno division No. 6; W. L. Clark, Los Angeles, division No. 7.

W. E. Davis, vice president in charge of sales of the Goulds Manufacturing Company, Seneca Falls, N. Y., has just started on an extensive trip to visit their representatives in Boston, New York, Philadelphia, Richmond, Pittsburg, Wheeling, Cleveland, Warren, Cincinnati, Louisville, Chicago, St. Louis, Kansas City, Joplin, Memphis, Birmingham, Montgomery, Mobile, New Orleans, Beaumont, Houston, Galveston, San Antonio, El Paso, Phoenix, Tuscon, Albuquerque, Los Angeles, San Francisco, Portland, Seattle, Tacoma, Boise, Salt Lake City, Denver and Omaha, and expects to complete his trip and return to Seneca Falls early in March.

MACHINERY AND TRADE

Germicidal Value of Calcium Chloride.

The use of calcium chloride as a road binder has been commented upon and its action fully described in these pages. A new factor, namely, its antiseptic value, has recently been demonstrated and this, combined with its value as a dust layer, makes it particularly desirable for use in residential districts, on playgrounds, near reservoirs, etc.

Tests of the germicidal value of solutions of calcium chloride upon bacteria coli communis, made by M. L. Trowbridge, indicate that a solution of 2 per cent. of chloride of calcium inhibits the growth of bacterial life within a period of three to four hours. Higher strengths up to 15 to 20 per cent. destroy all bacterial life in from ten to fifteen minutes.

When calcium chloride is put upon roads for the purpose of laying dust, whether in solution or in the granulated form, it soon takes up moisture from the air or gives up moisture to the air until it comes to a state of equilibrium with the moisture in the air. Under ordinary conditions of humidity in the summer calcium chloride upon roads is reduced by the moisture in the air to a solution containing from about 15 to 40 per cent. calcium chloride. In rainy weather this solution is diluted considerably, but after the rain ceases it again concentrates with evaporation of water to the strength mentioned above.

It is, therefore, clear that calcium chloride, when used upon roads in sufficient amounts to lay the dust, exists as a solution containing a sufficient amount of calcium chloride to be fatal to all bacterial life.

Actual tests upon roads treated with calcium chloride and roads in the same vicinity not treated with calcium chloride show that over 98 per cent. of the bacteria present in the road surfaces are destroyed by the calcium chloride dust treatment. In fact, a road properly treated with calcium chloride and protected from additional contamination will become absolutely sterile.

Since the dust from roads and city streets is acknowledged to be the most common means of spreading contagious diseases, the calcium chloride treatment for laying dust not only contributes to the general comfort, but to a great extent, not yet fully appreciated, to the general public health.

Books on Sewage Lifting Apparatus.

"The Priestman Ejector System" and "Progress in Sewage Treatment, No. 7," have just been issued by Merritt & Co., Camden, N. J., and deal mainly with the Priestman ejector system and the subject of sewage pumping. "The Priestman Ejector System" contains 14 pages and takes up first the various applications of the Priestman hydro-pneumatic ejector. These applications are discussed at further length after a page devoted to a description of how a Priestman ejector operates, attention being directed to the absence of moving parts in contact with the sewage and how the compressed air is made to work expansively for discharging sewage. In subsequent pages the various advantages of this type of sewage pumping apparatus are given, and also details regarding its construction. Standard dimensions of the horizontal type are not included since the design and installation of horizontal ejectors depends upon local conditions. Ejectors of this type are used where the amount of head room available is very limited. The last two pages comprise data sheets which outline the figures which are necessary for proper recommendation of the ejector systems in basements of deep buildings or for city pumping stations.

The second publication, "Progress in Sewage Treatment No. 7," is a technical paper, 18 pages of which are devoted to articles, 3 to editorial matter and 3 to advertisements. The leading article is from a report by Mr. Geo. T. Hammond, M. Am. Soc. C. E., and is entitled "Automatic Sewage Lifting Station Equipment." It analyzes the various advantages of the centrifugal pump and the compressed air ejector.

Following Mr. Hammond's article, some 6 pages are devoted to an article on pneumatic ejectors abstracted from the Surveyor, London, and another describing the sewage ejectors at the Pennsylvania station, New York.

In the editorial section a page is devoted to the water waste at Memphis by flush tanks, and another to the subject of Mr. Hammond's paper. Particular reference is made to the table of efficiency of compressed air in ejectors and a note is given covering the equations for adiabatic air compression.

The Dolarway Bituminous Surface Concrete Pavement.

Road authorities generally recognize that if durability is desired it is a mistake to lay a pavement without a concrete foundation. The only reason for not using such a foundation in the past on all pavements has been the matter of cost. The introduction of a pavement known as the Dolarway pavement has now made it possible to construct a highway with a concrete foundation at a cost of a little over a dollar per square yard.

After several years' experience with Dolarway pavement at Ann Arbor, Mich., during which time about 100,000 square yards were laid, the authorities are enthusiastic and declare it to be the most satisfactory and economical pavement they have ever used.

trols the Dolarway pavement and is now making arrangements with local contractors to lay this form of pavement in various parts of this country and Canada. Considerable of the territory has been already allotted, as the proposition, owing to the low cost of the pavement, is a most attractive one from the contractor's standpoint.

Engineers, contractors or city authorities interested in this proposition may obtain further information from the Dolarway Paving Company, either at their New York office, 95 Liberty street, or their western office, 510 Title and Trust building, Chicago.

A Gas Engine Water Works Pumping Plant.

The high economy of the gas engine driven power pump is generally known, and interesting data on results obtained with this type of pumping equipment are fre-

ONE OF THE METHODS OF APPLYING AND SPREADING DOLARWAY BITUMEN ON CONCRETE BASE.

The construction consists of from five to six inches of Portland cement concrete provided with the necessary expansion joints. The surface is then treated with adhesive Dolarway bitumen and with coarse sand or fine gravel or screenings. This seals the concrete, prevents cracking and chipping and produces a wearing surface which is clean, noiseless, resilient and similar in appearance to other forms of bituminous pavement. From the fact that no machinery is necessary for the construction of the Dolarway pavement and from the further fact that it is constructed almost entirely out of local materials, with little or no skilled labor required, this proposition is an unusually economical one.

The Dolarway Company owns and con-

quently brought to attention. The results obtained in the plant of the Bellevue water works, Bellevue, Ohio, are of particular interest, a saving of 75 per cent. having been shown in the plant by the installation of this type of equipment. This includes the cost of fuel only; if the other items, such as maintenance, attendance, etc., were taken into consideration, even greater increases in economy would probably be shown.

In this city an average of between 600,000 and 800,000 gallons of water, against a normal pressure of about 42 pounds and a fire pressure of 110 pounds, is pumped in 24 hours. The stand pipe is cut out in case of fire and the pressure is taken direct from the pump.

The original equipment, which has been in service several years, consisted of a reciprocating steam pump. About a year ago this equipment was replaced by a double-acting triplex power pump, made by the Goulds Manufacturing Company, Seneca Falls, N. Y., and a natural gas engine, made by the Bruce-Macbeth Engine Company, Cleveland, Ohio. The pump has 9 in. cylinders and the engine is rated at 55 horsepower.

Bellevue is located in the natural gas belt and they obtained gas for fuel under the boiler for the old steam pump equipment at a cost of 15c per thousand feet. The gas for the engine now used costs them 30c per thousand feet.

During the month of August, 1910, with the steam pump they pumped 20,000,000 gallons at a fuel cost for gas under the boilers of $128.

During the month of August, 1911, with the new power pump equipment they pumped 21,000,000 gallons at a fuel cost for gas supplied to the engine of $31.

During a test of nine days the gas engine and power pump delivered 5,900,450 gallons of water with a gas consumption of 31,000 feet. This is equivalent to about 5 cu. ft. of gas per 1,000 gallons, giving a cost of 3/20 of 1 per cent. per thousand gallons.

The Stewart Sewer Cleaning Machine.

Some practical, efficient form of sewer cleaning device is a most essential part of the equipment of the sewer department of any city. This fact has been established and proven by the experience of many cities and towns.

W. H. Stewart, Sixteenth and Locust streets, St. Louis, Mo., has been demonstrating for a number of years the efficiency of the Stewart sewer cleaning machine, using for purposes of introduction a rental proposition, which allowed of the rental fee being applied upon the purchase price. During this time the machine has been used in more than one hundred cities.

The Stewart patent sewer cleaning machine is of the drag type, consisting of a set of buckets semi-circular and cone shape, having the large end open. Heavy iron rod form a guard which prevents the bucket from dragging on the bottom of the sewer and catching on high or rough joints. The bucket is operated with a cable attached to each end and a windlass at each manhole. A bucket of a smaller size than the diameter of the sewer is first drawn into the sewer backwards as far as possible over the dirt, then in pulling forward, the pull coming from the upper back corner of the bucket, as it is hung there, forces the digging edge to the bottom of the sewer, and as it is drawn out it carries to the manhole not only the bucket full of dirt, but also a considerable amount of dirt which is pushed ahead of the bucket. The dirt ahead of the bucket is taken out by shoveling it into a pail and hoisting through the manhole. The machine bucket can either be dumped in the manhole and shoveled out or hoisted to the surface and dumped.

ENGINE TYPE STEWART SEWER CLEANING MACHINE.

The buckets are made of boiler steel, about ⅛ of an inch thick and from 12 to 36 inches in length, with a cage of iron from ⅜ to ¾ of an inch in diameter, according to size. The largest size is made to go in a manhole in sections. These are for trunk line sewers and do not come to the surface full.

When being drawn back into the sewer

(for a distance according to the amount of sediment), the bucket, hanging as it does from the upper edge of the cage, allows the point to rise easily, and if the sediment is very hard the construction of the cage is such that it will positively cut into it and loosen it up, because the top of the cage touches the top of the sewer and cannot rise.

The accompanying photograph shows a new type of the Stewart machine. The motive power for the buckets on this machine is a 3 to 5 h.p. air-cooled gasoline engine, provided with special clutch connections. A double-geared windlass and extra frame is provided for use in case it is desirable to use hand power.

W. H. Stewart also manufactures a special hook sewer and conduit rod, which is widely used.

Attractive Ornamental Light Standards.

The Davenport Machine and Foundry Company, Davenport, Iowa, have a very attractive line of electric light poles or standards for streets, boulevards and parks. A booklet issued by them contains photographs and descriptive matter relating to twelve of their principal designs.

The standards shown are for the most part adaptions of the classic column forms, with ornamental bases and arms and short column heads, supporting the lights and globes. The height of the five-light cluster standards shown is in most cases 12 feet 9 inches to the top of the center globe. Ten-inch side globes and fourteen-inch top globes are specified in most cases.

The Davenport Machine and Foundry Company also manufacture a very complete line of municipal castings, such as manhole covers and rings, catch basin frames and grates, inlets, etc., in addition to heavier structural shapes.

The Hetherington & Berner Brick Testing Machine.

Hetherington & Berner, Indianapolis, Ind., have placed on the market a brick rattler which is constructed strictly according to the National Paving Brick Manufacturers' standard.

Owing to the indefiniteness of the specifications for a rattler, which were adopted at the meeting in 1901, the rattlers that were built under the said specifications did not produce uniform results, and the matter was taken up by the N. P. B. M. Association and the specifications were revised and improved by the committee and presented to and adopted by the National Paving Brick Manufacturers' Association at its meeting in Louisville in February, 1911. The revised specifications are those under which are constructed the testing rattler built and offered to municipalities and to the brick-making trade by Hetherington & Berner.

For the abrasive charge the Hetherington & Berner machine is supplied with spheres of a special grade iron according to the following composition:

Combined Carbon—Not less than 2.50 per cent.

Graphite Carbon—Not more than 0.10 per cent.

Silicon—Not more than 1 per cent.

Manganese—Not more than 0.50 per cent.

Phosphorus—Not more than 0.25 per cent.

Sulphur—Not more than 0.08 per cent.

An extra 200 pounds of shot is furnished with each machine, making 500 pounds in all supplied.

Hetherington & Berner have a special descriptive circular giving the full specifications, directions for testing and a list of parts for this machine.

H. W. Johns-Manville Co. in Louisville.

Owing to their fast increasing business in Louisville, Ky., the H. W. Johns-Manville Company have found it necessary to move their offices from the Lincoln Savings Bank building to 205 Paul Jones building. These new and more spacious quarters are much better adapted to their requirements.

The office will be in charge of Mr. J. R. Chowning, who is well known throughout that section, having traveled in that section from the Milwaukee office a considerable time. A complete line of J-M asbestos and magnesia products, electrical supplies, packings, pipe coverings, roofings, etc., will be handled from this office.

Trade Publications.

The General Fire Extinguisher Company, Providence, R. I., has a quarterly bulletin known as the Automatic Sprinkler Bulletin. This quarterly publication, devoted to the interests of fire prevention from the standpoint of the automatic sprinkler, contains a great deal of detailed information regarding the actual operation of sprinklers in cases where fires call them into action. The January number carries with it digests of the reports of the Chamber of Commerce of Rochester, N. Y., and Boston, Mass.

C. A. P. Turner, 816 Phoenix building, Minneapolis, Minn., has issued Bulletin 12, giving examples of the "Mushroom" system of reinforced concrete construction. Photographs and much detailed information are contained in the bulletin. The wide distribution of the work can be judged from illustrations in this publication showing buildings scattered from Portland, Me., in the east, to Portland, Ore., in the west, and from the cities of Winnipeg, Man., and Regina, Sask., in the north to Melbourne, Australia, in the south.

The American Asphaltum and Rubber

Company, 600-617 Harvester building, Chicago, Ill., has published an attractive reprint of a short poem, "The Army of God Knows Where," by Alfred Damon Runyon. The poem is dedicated to "our civil engineers," and shows an appreciation of the civil engineer as a pioneer in all great works.

The J-M sectional conduit is fully described and very completely illustrated in Catalog No. 112 of the H. W. Johns-Manville Company, 100 William street, New York, N. Y. The conduit described is manufactured from a thoroughly ground and mixed combination of stoneware clay, fire clay and spar; and is molded in two sections, an invert and a covering, which may be united in place by cement. The catalog is very complete and is a very valuable addition to the files of the engineer or contractor.

Bulletin No. 102 of the Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, Mo., treats of the Diesel oil engine as applied to brewery and ice plant requirements. A very complete technical discussion is given in addition to tables of dimensions, weights and power ratings of two of their types of engine.

The Lehigh Portland Cement Company, People's Gas building, Chicago, Ill., has a new form of publication, which is in fact a small magazine devoted to Lehigh cement and the dealers who distribute it. "Lee-Hi," the new addition to their advertising force, receives an introduction in the first issue of their new publication.

The following are some of the articles in the current number of "Lubrication," a quarterly publication of The Texas Company, New York: "Losses Caused by Inadequate Filtering Systems," "Conditions Where Lubrication Has Been Impossible," "Practical Troubles Remedied," "An Unusual Condition in Hydraulic Pump Work."

The Thomas "Acme" air-cooling and purifying system is described in two pamphlets published by Thomas & Smith, 116-118 North Carpenter street, Chicago, Ill.

The January Bulletin of the Universal Portland Cement Company, 72 West Adams street, Chicago, Ill., contains among other matters of interest illustrated descriptions of concrete piles for foundations, a county bridge of concrete, concrete building construction and concrete pavement construction.

The Goulds Manufacturing Company, '31 West Fall street, Seneca Falls, N. Y., has for distribution three bulletins: No. 107, "Deep Well Triplex Pumps"; No. 108, "Deep Well Working Heads," and No. 109, "Pumps for Special Service."

Trade Notes.

ASPHALT.

Kearney, Neb.—After considerable discussion relative to the merits of different kinds of material, the council has ratified the choice of bitulithic manufactured by the Warren Brothers Company, 59 Temple place, Boston, Mass., for use in the paving of Kearney avenue.

MACHINERY.

Quitman, Ga.—The purchase of road machinery and a gasoline traction engine is contemplated by the county commissioners of Brooks county.

Dana, Ind.—Special—H. L. Fillinger desires information regarding ditching machines for digging tile ditches.

Laurenburg, N. C.—Special—Moxey L. John desires to purchase a transit for city work.

Cleveland, O.—The purchase of automobile trucks for hauling trains of garbage wagons is contemplated. W. J. Springborn is director of public service.

MISCELLANEOUS.

The MacArthur Concrete Pile and Foundation Company, 11 Pine street, New York, have been recently awarded the following Pedestal concrete pile contracts: Foundations for a manufacturing building, Saginaw, Mich., for Hammond-Standish; architects, Coles & Mutcheller, Saginaw. Foundations for a warehouse building at Hamilton, Ont., for Oliver Chilled Plow Works, ltd., of Canada. Prack & Perrine are the architects. The third contract is for a foundation for a three-quarter-million-dollar court house for Fulton county, Atlanta, Ga. Over 1,200 Pedestal piles are being driven. A. TenEyck Brown and Morgan & Dillon are the architects.

Patents Concerning Apparatus for Preparing and Handling Concrete and Concrete Materials.

893,168. Cement Spreading Machine. Isaac Hewitt, Victoria, B. C. Canada.

928,858. Concrete Holding and Carrying Device. Arthur N. Doud, North Stockholm, N. Y.

932,746. Cart for Distributing Concrete, Etc. Nils F. Ambersen, Newton, Mass.

934,092. Bucket for Concrete Building Material. Nicholas C. Newer, Buffalo, N. Y.

951,754. Method of Handling Plastic Material. Josiah W. Buzzell, E. Orange, N. J., and Wm. H. Larking, Jr., Laporte, Ind.

957,565. Apparatus for Separating Gravel from Sand, Etc. Carsten E. Fergusen and Wm. Idstrow, New Orleans, La.

968,928. Sand and Gravel Separator. Herbert A. Frankenstein and Frank H. Amos, South Bend, Ind.

972,792. Mortar Feeding Device. Chas. E. Allred, Oakland, Cal.

978,693. Apparatus for Washing Sand and Like Material. Seth A. Capron, Westfield, Mass.

989,263. Gravel Loader and Excavator. Fred Hallowell, Orleans, Ind.

990,194. Loader for Concrete Mixers. Jas. DuShane, South Bend, Ind.

991,450. Concrete Conveyor and Distributer. Geo. Mingo, Cedar Rapids, Iowa.

991,814. Apparatus for Mixing and Applying Plastic or Adhesive Materials. Carl E. Akeley, Chicago, Ill.

992,724. Concrete Bucket. Willard D. Lockwood, Schenectady, N. Y.

1,004,663. Rock Crusher. John M. Landrum, East Lake, Ala.

1,005,138. Bucket for Transporting Plastic Material. Chas. L. Bartlett, Cedar Rapids, Iowa.

1,005,516. Furnace for Drying Sand and Crushed Stone. Wm. D. Craven, Jr., Ridley Park, Pa.

IMPROVEMENT AND CONTRACTING NEWS

RMP

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Atlanta, Ga.—February 5, 3 p. m. Street improvement work during 1912 as follows: 1. Furnishing and setting granite curbing. 2. Furnishing and setting concrete curbing. 3. Furnishing and laying tile sidewalks. 4. Furnishing and laying sheet cement sidewalks. 5. Furnishing and laying brick sidewalks. 6. Furnishing gravel. 7. Furnishing brick for repair work. 8. Furnishing stone and crushed stone for macadam. 9. Furnishing cement for street department. R. M. Clayton, chief of construction.

Rome, Ga.—February 14. Paving First street between Third and Second avenues, and Third avenue betwen Broad and East First. Board of Public Works.

Lawrenceburg, Ind.—February 6, 12 m. Constructing road in Jackson township. William S. Fagely, auditor.

Logansport, Ind.—February 6, 10 a. m. Constructing macadam road in Tipton township. J. W. Wallace, auditor.

Madison, Ind.—February 6, 1 p. m. Constructing macadamized road in Madison township. A. M. Hass, auditor.

Monticello, Ind.—February 6, 12 m. Constructing stone roads in Big Creek township. A. B. Fisher, auditor.

Rensselaer, Ind.—February 6, 3 p. m. Constructing macadam road in Wheatfield township. Joseph P. Hammond, auditor.

Williamsport, Ind.—February 5. Constructing gravel roads in Steuben and Jordan townships. E. H. Moffitt, auditor.

Winamac, Ind.—February 6, 12 m. Constructing highway. W. E. Munchenburg, auditor.

Decatur, Ind.—February 5, 10 a. m. Constructing 5 macadam roads. H. S. Michaud, auditor.

Vincennes, Ind.—February 6, 2 p. m. Constructing gravel road in Vigo, Vincennes and Busseron townships. John C. Scott, auditor.

Topeka, Kas.—February 19. Furnishing a road roller and grader. Board of County Commissioners.

Tompkinsville, Ky.—March 8. Constructing 4 miles of pike. Certified check, $200. C. L. Bradshaw, chairman Board of Road Commissioners.

Winona, Minn.—April 9. Constructing 21 miles of macadam road. Jos. Winczewski, county auditor.

Steubenville, O.—February 15, 12 m. Grading, macadamizing and draining the Smithfield and Hopedale road under the following sections: Section 1, 10,283 feet; section 2, 9,735 feet; section 3, 984 feet. Certified check, $500 on each bid. Howard M. Bell, chairman road commissioners

Jonesboro, Tenn.—February 15. Constructing portion of the Memphis-Bristol highway. Engineer Huffaker, Jonesboro, Tenn.

Racine, Wis.—February 3. Constructing 10,900 sq. yds. pavement, 2,221 lineal ft. concrete gutter and 2,723 lineal ft. concrete curb and gutter. P. Connolly, city engineer.

CONTRACTS AWARDED.

Lodi, Cal.—Paving Sacramento, Pine and Elm streets, to the Ransome-Crunney Co., $35,672.

Los Angeles, Cal.—Paving Wilshire boulevard, to the Barber Asphalt Co., $227,109.

Monterey, Cal.—Paving Pine street, to the P. A. Work Co., $13,300.

Hartford, Conn.—Paving Albany avenue and Scarborough street, to the Hartford Paving and Construction Co., Hartford, Conn., $17,849.

Chicago, Ill.—The following paving contracts have been awarded: Indiana street, with granite, to James A. Sackley & Co., Chamber of Commerce, Chicago, Ill., $30,786; Western avenue, with brick, to the Calumet Coal & Teaming Co., 2946 East 95th street, Chicago; Lawndale avenue, with brick, to the Citizens' Construction Co., 133 West Washington street, Chicago, $27,417; West 59th street, with brick, to the Calumet Coal and Teaming Co., $34,858; 56th street, with brick, to the Rennaker Construction Co., 9 South La Salle street, $14,000; 43d avenue, with brick, to the Citizens' Construction Co., $10,333; Exchange avenue, with macadam, $48,572, and Charles street, with macadam, $29,194, to Farr Bros., 356 West 111th street, Chicago; Avenue N, to the Illinois Improvement and Ballast Co., 72 West Adams street, $17,029; alleys in Arlington place, with brick, to the Central Paving Co., 179 West Washington street, $4,832; alleys in Washington boulevard, with brick, to James A. Saxley Co., $1,860; alleys, Wilson avenue, etc., with brick, to the Central Paving Co., $2,985.

Rockford, Ill.—Paving North Water street with brick, to A. E. Rutledge, $9,000.

Benton, Ind.—Constructing the Pitscick road, to Nicoson & Pierce, Alexander, Ind., $10,832.

Fowler, Ind.—Constructing the Schnider road and a series of streets, to George Matthews, $7,157.

Louisville, Ky.—Constructing the Bardstown road, to the American Standard Asphalt Co., Louisville, Ky.

Louisville, Ky.—Paving Spratt street, to B. W. Gosnell, $13,200.

New Orleans, La.—The following paving contract has been awarded: Burgundy street, to Thomas Egan, $55,283.

Minneapolis, Minn.—Furnishing 175,000 yards of creosoted wood block for paving, to A. W. Van Hassten.

Maplewood, Mo.—The following paving contracts have been awarded: Manchester road, to the E. A. Heman Construction Co., St. Louis, Mo., $21,200; constructing sidewalks, to the Graham Granitoid Co., St. Louis, Mo., $18,183.

Lincoln, Neb.—Constructing pavements in 4 districts, to Able & Roberts, $46,600.

Ocean City, N. J.—Constructing Ocean City boulevard, to Sutton & Corson Co., Ocean City, N. J., $94,258; constructing Sea Isle City road, to H. Y. Clouting, of Beesle's Point, $24,971.

Cincinnati, O.—Constructing sections of the Ludlow avenue viaduct, to C. H. Glandorff, Thomas P. Strack and the Kirchner

Construction Co., Cincinnati, O. Contract price, $259,585.

Cincinnati, O.—Constructing asphalt pavement on Hackberry street, to Henkel & Sullivan, $13,767; paving Moorman avenue with asphalt, to the same, $6,035.

Cincinnati, O.—Constructing the Shady Lane road, to Van Camp Bros., Newtonville, O., $18,143.

Dayton, O.—Constructing brick pavement and storm sewers in Burkhart avenue, to E. M. Gebhart, $41,605; paving Rubicon street, to Warren Bros. Co., Boston, Mass., $1,217; constructing sidewalks and grading Huffman avenue, to A. J. Kammer, $1,150.

Findlay, O.—Constructing 3½ miles of stone road, to Chas. Edgington, McComb, O., $18,195.

Toledo, O.—Constructing municipal asphalt plant, to the East Iron Machine Co., Lima, O., $9,000.

Youngstown, O.—The following street contracts have been awarded: Grading Plum street, to James Cumisky, $900; paving Glenhaven street, to Miller Bros., $4,073; paving Grace avenue, to Miller Bros., $6,952; paving Walnut street, to Charles Harris, $12,629.

Portland, Ore.—Paving Raleigh street, to the Warren Construction Co., $52,000.

Portland, Ore.—Resurfacing Sandy boulevard, to the Oregon Independent Paving Co., $192,000.

Greensburg, Pa.—The following road contracts have been awarded: The Puckety Creek road, to Reinhardt Bros., East Liverpool, O., $42,018; Perrysville road, to the Duster Contracting Co., of Tarentum, Pa., $48,897.

Wilkesbarre, Pa.—Constructing roads in Luzerne county have been awarded as follows: Section 1, to B. G. Coon, Dorrancetown, at $55,450; section 2, to E. P. Post, Wilkesbarre, at $60,417; section 3, to Herrick Construction Co., at $40,695; section 4, to Freeland Construction Co., Freeland, at $82,416.

Dallas, Tex.—Paving Collett avenue and East Side avenue with asphalt macadam, to the Standard Engineering and Construction Co., Dallas, Tex.

Seattle, Wash.—Paving 26th avenue, to Becker & Walker, $15,207.

Kenosha, Wis.—Constructing 9,500 sq. yds. of vitrified brick pavement, to the White Construction Co., Majestic building, Milwaukee, Wis., $18,000.

Edmonton, Alta., Can.—The Bitulithic Paving and Contract Co., of Winnipeg, has been given the contract for constructing 75,000 sq. yds. of bitulithic pavement during 1912, and the National Paving and Contracting Co., of Winnipeg, has been awarded contracts for 25,000 sq. yds. of asphalt paving during 1912. A. J. Lagorell, city engineer.

CONTEMPLATED WORK.

Little Rock, Ark.—The paving of West 23d street, to cost about $45,000, is contemplated. W. S. Reichardt, engineer.

San Diego, Cal.—A $1,250,000 bond issue for 450 miles of highway and boulevard has been voted.

Stamford, Conn.—A $50,000 bond issue for the paving of West Main street and Elm street has been authorized.

Quitman, Ga.—The purchase of road machinery and a gasoline traction engine is contemplated. The county commissioners of Brooks county.

Sylvester, Ga.—A $20,000 bond issue for road improvement has been voted.

Centralia, Ill.—The paving of about 8 miles of street is contemplated. L. F. Trainor, city engineer.

Chicago, Ill.—The construction of a creosoted block manufacturing plant to cost about $60,000 is contemplated. L. E. McGann, commissioner of public works.

Kankakee, Ill.—The paving of West Court street with vitrified brick, to cost about $21,000, is contemplated.

Mattoon, Ill.—The paving of about twenty miles of roadway in Mattoon township with brick is contemplated. Estimated cost about $140,000.

Moline, Ill.—The paving of 23d avenue with brick, to cost $37,840; 14th avenue with asphalt, to cost $17,322, and 13th street, to cost $4,584, is contemplated.

Peoria, Ill.—The paving of Linn street, to cost about $20,000, and the paving of Spring street, to cost about $11,000, is contemplated.

Rockford, Ill.—The paving of East State and Charles streets, estimated cost $44,790, is contemplated.

Waukegan, Ill.—Paving construction as follows is contemplated: Steele Court and Corey avenue, estimated cost $15,900; Lawn Court with macadam, $1,006; Gillette avenue with brick, estimated cost $9,789.

Bourbon, Ind.—The construction of about two miles of 28-foot brick roadway is contemplated for 1912. V. C. Keller, president board of trustees.

Elkhart, Ind.—The paving of about two miles of street, to cost about $65,000, is contemplated.

Davenport, Ia.—Proposals for the city paving during 1912 will probably be asked by the Board of Public Works on Feb. 6.

Webster City, Ia.—The construction of 20 blocks of concrete asphaltic concrete or brick pavement is contemplated.

Murray, Ky.—The county court has appropriated $10,000 for the construction of the Jefferson Davis highway.

Kalamazoo, Mich.—The paving of a number of streets with macadam, estimated cost $80,000, is contemplated. H. A. Johnston, engineer.

Menominee, Mich.—Road improvements to cost about $100,000 are contemplated by Menominee county.

Owosso, Mich.—A $15,000 bond issue for paving construction has been voted.

Fulton, Mo.—A $100,000 bond issue for the construction of permanent roads has been voted.

Wentworth, Mo.—The construction of a 13-mile gravel road to connect Wentworth and Diamond, Mo., is contemplated.

Avon, N. Y.—An $18,000 bond issue for street improvement has been voted.

Canal Dover, O.—The paving of a number of streets, to cost about $32,000, is contemplated.

Canton, O.—The paving of West 9th street and Lynch street, to cost about $19,000, is contemplated. Phil H. Webber, city engineer.

Cincinnati, O.—A $203,500 bond issue for paying the city portion of the street and alley improvement has been voted.

New Philadelphia, O.—Constructing two miles of roadway, to cost about $13,000, is contemplated. County commissioners of Tuscarawas county.

Portland, Ore.—The establishment of a municipal street repair plant is contemplated.

Blountville, Tenn.—A $200,000 bond issue for road construction has been voted by Sullivan county.

Gallatin, Tenn.—A $200,000 bond issue for the construction of roads has been voted.

Knoxville, Tenn.—A $15,000 bond issue for paving construction has been sold.

Beaumont, Tex.—A $60,000 bond issue for paving improvements and a $60,000 bond issue for park extension have been voted.

Comanche, Tex.—A $1,600,000 bond issue for the construction of roads and bridges in the county has been voted.

Lufkin, Tex.—Road improvements to cost about $200,000 are contemplated.

Mexia, Tex.—A $150,000 bond issue for road construction has been voted.

Midland, Tex.—The construction of sample stretches of highway for educational purposes is contemplated.

Palestine, Tex.—A $150,000 bond issue for road construction has been sold.

Sherman, Tex.—A $400,000 bond issue for road construction has been voted.

Tehuacana, Tex.—A $150,000 bond issue for the construction of roads in Limestone county has been voted.

Victoria, Tex.—A $200,000 bond issue for road improvements has been voted.

Barton Heights, Va.—A $20,000 bond issue for water works construction and sewerage and paving improvements has been voted.

Lynchburg, Va.—A $550,000 bond issue for street improvement and sewer construction has been voted.

Richmond, Va.—The construction of a boulevard to Riverside Park to cost about $12,000 is contemplated. Chas. B. Bolling, city engineer.

Bellingham, Wash.—The paving of Meridian street to cost about $60,000 is contemplated.

Everett, Wash.—The construction of a boulevard to Mukilteo, a distance of three miles, is contemplated.

Milwaukee, Wis.—Street paving to the amount of $2,397,450 is contemplated as follows: Asphalt, 1,000,000 sq. yds., estimated at $1,500,000; stone block, 50,000 sq. yds., estimated at $175,000; macadam, 10,000 sq. yds., estimated at $10,000. Harry E. Briggs, commissioner of public works.

Woodstock, Wis.—A $25,000 bond issue for paving construction has been voted.

SEWERS.

BIDS REQUESTED.

Pine Bluff, Ark.—Feb. 17, 3 p. m. Constructing sanitary sewers in District No. 1. Certified check, $300. William J. Parks. Citizens Bank building, engineer; T. A. Wilson, president commissioners.

Atlanta, Ga.—Feb. 5, 3 p. m. Sewer construction during 1912 as follows: 1, constructing eastern section sewer; 2, constructing western section sewer; 3, furnishing vitrified sewer pipe; 4, furnishing castings for sewer; 5, furnishing cement for sewers. R. M. Clayton, chief of construction.

Mattoon, Ill.—Mch. 1. Constructing vitrified pipe sewers. C. L. James, city engineer.

Hannibal, Mo.—Feb. 29, 12 m. Sewer construction as follows: Estimated cost of work, $37,000; 10,000 ft. of 6-in., 6,000 ft. of 7-in., 3,000 ft. of 8-in., 500 ft. of 12-in. pipe, 1,200 ft. of 6x8 concrete box, 1,300 ft. of 6x6 concrete box, 1,100 ft. of 6x4 concrete box and 500 ft. of 2½x2½ concrete box. No excavation or fill on concrete part, shallow excavation on vitrified pipe. B. F. Smiley, city engineer.

Watervliet, N. Y.—Feb. 14, 2 p. m. Sewer construction as follows: 80,000 cu. yds. of earth excavation; concrete overflow and outlet works, 9,100 ft. concrete conduit from 3 ft. to 8 ft. 6 in. in diameter; 1,000 ft. of terra cotta sewer pipe. Certified check, 5 per cent. John D. Brown, president sewer commission; Solomen, Norcross & Keif, Atlanta, Ga., engineers.

Madison, S. D.—Feb. 15, 8 p. m. Constructing sewage disposal works as follows: Settling tank, contact and filter beds; 5,000 lbs. structural steel, 175 cu. yds. reinforced concrete, 1,500 ft. 4-ft. to 18-inch drain tile, 1,000 ft. 6-in. to 10-in. gutter pipe, 200 lin. ft. 18-in. double strength sewer pipe. Certified check, $500. George H. Waskey, mayor; William Rae, city auditor.

Mitchell, S. D.—Feb. 5, 8 p. m. Sewer construction as follows: Branch R, 1,292 ft. 8-in. pipe, 4 manholes; Branch R, 1,065 ft. 8-in. pipe, 3 manholes; Branch T, 1,690 ft. 8-in. pipe, 4 manholes. Certified check, 5 per cent. on each bid. M. H. Jenson, city auditor.

CONTRACTS AWARDED.

Mobile, Ala.—Constructing concrete storm sewers in the tenth paving district, to Sullivan, Long and Hagerty, Bessemer, Ala.

San Francisco, Cal.—Construction Section C of the Ingleside outlet sewer, to the Contra Costa Construction Company, San Francisco, Cal., $60,500.

Denver, Colo.—Constructing sewers in sub-District No. 14, to the Denver and Pueblo Construction Co., Denver, Colo., $50,732.

Hartford, Conn.—Constructing sewers as follows: 2,700 ft. in Scarborough street and 2,300 ft. in Albany avenue, to the Hartford Paving & Construction Co., Hartford, Conn.

Unadilla, Ga.—Constructing sewers and a water works system, to Walton & Wagner, $22,825.

Vincennes, Ind.—The city has contracted with the Vincennes Sewer Association for the construction of a complete sanitary system to be rented by the city for a period of 25 years.

Atchison, Kan.—Constructing a sewer in West Atchison, to Williams & Sample, Kansas City, Mo., $22,560.

St. Paul, Minn.—Constructing the Snelling-Edmund sewer system, to Gilbert W. Haggert, Fargo, N. D., $39,000.

Kansas City, Mo.—Constructing tile sewers in Raytown road, to T. W. Roberts, $26,461.

St. Louis, Mo.—Constructing sewers in Lindenwood, Sewer District No. 1, to John S. McMahon, $19,820.

Las Cruces, N. M.—Constructing sewers and a water works system, to Bash & Gray, Joplin, Mo., $54,953.

Gates, N. Y.—Constructing sewer in Otis street, to Whitmore, Rauber & Vicinus, Rochester, N. Y., $42,298.

Johnstown, N. Y.—Constructing a 30-in. trunk sewer and lateral, to Chas J. McAleer, 1307 Lafayette street, Schenectady, N. Y.

Rochester, N. Y.—Constructing Contract No. 3 of the intersecting sewers, to Whitmore, Rauber & Vicinus, Rochester, N. Y., $261,845.

Troy, N. Y.—Constructing the Pawling avenue intercepting sewer, to Evelind Bros., Waterford, N. Y., $28,323.

Dayton, O.—Paving and constructing sewers in Burkhart avenue, to E. M. Gebhart, $41,605.

Springfield, O.—Constructing a Belmont avenue sewer to Hounker & Williams, $10,451.

Springfield, O.—Constructing sewers in Columbia street, to M. J. Cooney, $9,030.

Oklahoma City, Okla.—Constructing an electrolytic sewage disposal plant, to J. A. McMahan & F. E. Bennett, $16,582.

Waco, Tex.—Constructing extensions to a sanitary sewer system, to H. C. Gass, Independence, Kan.

North Yakima, Wash.—The city commission has rejected the bids of Robinson & Foster, of Spokane, and awarded the construction of the West Side sewer to B. T. Daniels, of North Yakima, Wash., $43,031.

Toppenish, Wash.—Constructing a complete sewer system to cost about $50,000, to McKim, Nevin & Co., of Puyallup, Wash.

Lethbridge, Alta, Can.—Constructing a sewage disposal plant, to Hodson, Leader & Goode, of Lethbridge.

CONTEMPLATED WORK.

Fort Pierce, Fla.—A $30,000 bond issue for sewer construction has been voted.

Lakeland, Fla.—A $75,000 bond issue for sewer construction has been voted. C. S. Brush, city engineer.

Douglas, Ga.—A $10,000 bond issue for the construction of sewers has been voted.

McDonough, Ga.—The construction of a sewerage system to cost about $18,000 is contemplated.

Savannah, Ga.—A $600,000 bond issue for the construction of both storm water and sanitary sewers has been voted.

Sylvester, Ga.—A $20,000 bond issue for water works and sewer construction has been voted.

Kellogg, Idaho.—C. H. Green, Spokane, Wash., has prepared plans and specifications for a joint sewer system for Kellogg and Wardner, Idaho, to cost about $44,000.

Sand Point, Idaho.—A $14,000 bond issue for sewer construction has been voted.

Alton, Ill.—C. B. Stakemiller has been retained as the consulting engineer on the construction of a trunk sewer in Upper Alton.

Galesburg, Ill.—Construction of a sewer in East Main street to cost $18,000 is contemplated. F. N. Connelly, city engineer.

Rochelle, Ill.—The Aetna Engineering Bureau, 17 N. LaSalle street, Chicago, has prepared plans for the construction of a sewer system to cost $90,000.

Sparta, Ill.—The construction of a sewerage system to cost about $79,000 is contemplated.

Evansville, Ind.—The construction of a sewer to cost $15,000 is contemplated.

Griswold, Ia.—Bruce Standeven & Co., Omaha, Neb., have been retained to prepare plans for a complete sewerage system.

Mason City, Ia.—The city has been instructed by the Iowa state board of health to construct a sewage disposal plant.

Ottumwa, Ia.—The extension of the West End trunk sewer to cost about $66,000 is contemplated. John C. Brady, engineer.

Sioux City, Ia.—The construction of storm water sewers are contemplated.

Wardner, Ia.—The construction of sewers to cost about $20,000 is contemplated.

Columbus, Kan.—A $14,000 bond issue for sewer construction has been voted.

Lawrence, Kan.—The construction of storm sewers to cost about $17,300 is contemplated.

McPherson, Kan.—H. A. Rowland, city engineer, has been instructed to prepare plans for the construction of sanitary sewers.

Mulvane, Kan.—The construction of a sanitary sewer system to cost about $10,000 is contemplated.

Wabena, Minn.—John Wilson, consulting engineer, Duluth, Minn., has prepared plans for a complete sewer system to cost about $23,000.

Newark, N. J.—Rudolph Hering and John H. Gregory, 170 Broadway, New York City, have been retained to prepare plans for the construction of a sewage disposal plant for Orange and Montclair.

Middleport, N. Y.—Plans for a sewer system to cost about $55,000 are being prepared by Engineer Hopkins, Buffalo, N. Y.

Scarsdale, N. Y.—The installation of a sewerage system to cost about $125,000 is contemplated.

Athens, O.—A $10,500 bond issue for storm water sewer construction has been voted.

Cincinnati, O.—Sewer construction to cost about $95,000 is contemplated. J. J. Wenner, clerk department of public service.

Sallisaw, Okla.—Winters and Dove, Fort Smith, Ark., have been retained to prepare plans for a sanitary sewer system and sewerage disposal plant. A $45,000 bond issue has been sold.

Portland, Ore.—City Engineer Hurlburt has completed plans for an intercepting sewer to extend from Marquam Gulch to Nicolai street. Estimated cost, $500,000.

Everson, Pa.—A $15,000 bond issue for sewer construction has been sold.

Williamsport, Pa.—Plans are being prepared for a new disposal plant for the Warren State Asylum to cost about $45,000.

Beaumont, Tex.—A $30,000 bond issue for sewer construction has been voted.

Warwood, W. Va.—H. J. Watson, Wheeling, W. Va., has prepared plans for the construction of a sewerage system to cost $15,000.

Cowley, Wyo.—A $25,000 bond issue for water works and sewer improvements has been voted.

Barton Heights, Va.—A $20,000 bond issue for water works construction and sewerage and paving improvements has been voted.

Lynchburg, Va.—A $550,000 bond issue for street improvement and sewer construction has been voted.

WATER WORKS.

BIDS REQUESTED.

Stillwater, Minn.—Feb. 15, 3 p. m. Constructing steel standpipe. Louis W. Clark, engineer of board of water commissioners.

Manhasset, L. I., N. Y.—Feb. 15, 8 p. m. Water works construction as follows: Two 8-in. driven wells; brick pumping station; three sets of fuel oil engines, triplex pumps and accessories; oil tanks; water tower and foundation; 21 miles of cast iron pipe; 4 to 10-in; laying the same; 170 hydrants, valves and specials. Certified check, $8,000. Johnson & Fuller, 115 Nassau street, New York City, engineers; Daniel S. Wooley, chairman board of water commissioners of Manhasset-Lakeville water district.

Twist, Wash.—Feb. 15. Constructing water works system costing about $12,000. Town clerk.

Cumberland, Wis.—Feb. 27, 12 m. Constructing 4-in. water main. A. F. Wright, city clerk.

CONTRACTS AWARDED.

Exeter, Cal.—Constructing water works system complete, to C. E. Vincent, Oakland, Cal., $31,592.

Fullerton, Cal.—Constructing a reservoir, to C. E. Burker, Fullerton, Cal.

Alamosa, Colo. — Constructing water works improvements to cost about $10,000, to Marshall Bros.

Pueblo, Colo.—Constructing a concrete reservoir, to B. R. Gibbons, Pueblo, Colo.

Tallahassee, Fla.—Furnishing cast iron pipe for water works extension, to the Central Foundry Co., 90 West street, New York City.

Jessup, Ga.—Constructing water works system complete, to B. F. Roberts, Macon, Ga., about $30,000.

Unadilla, Ga.—Constructing sewers and a water works system, to Walton & Wagner, $22,825.

Lewiston, Idaho.—The laying of new water mains to cost about $6,000 is contemplated.

Tremont, Ill.—Constructing water main extension, to A. D. Thompson, Peoria, Ill., $8,327.

Audubon, Ia.—Constructing deep well at the city water works, to J. P. Keller Artesian Well Co., of Chicago, Ill.

Waterville, Kan — Constructing water works and electric lighting system, to the Des Moines Bridge and Iron Co., of Des Moines, Ia., $27,976.

Loreauville, La. — Constructing water works system complete, to the General Contract Co., New Orleans, La.

Boston, Mass.—Laying water pipe in Draper and Regent road, to Daniel K. Lynch, $1,051.

McComb, Miss. — Constructing water works extensions, to B. A. Heidenreichs & Co.

Manhattan, Mont.—Constructing water works system, to E. Lindstrom, Billings, Mont., $25,000.

Las Cruces, N. M.—Constructing water works and sewerage system, to Bash & Gray, of Joplin, Mo.

Charlotte, N. C.—Constructing pumping station for municipal water plant, to J. W. Haas, Charlotte, N. C., $20,000.

Euclid, O.—Constructing water main in Lake road, to Wilhelmi & Smith, 1329 Cove avenue, Lakewood, O., $30,319.

Olustee, Okla.—Constructing water works system, to E. B. Lundsen, Oklahoma City, Okla.

Portland, Ore. — The following water works improvements contracts have been awarded: 3,800 tons of cast iron pipe, to the Oregon Iron and Steel Co., Sherlock building, Portland, Ore., $117,900; 8,200 tons cast iron pipe, to the U. S. Cast Iron Pipe and Foundry Co., 71 Broadway, New York, $255,270; 500 tons cast iron pipe, to Smith and Watson Iron Works, 412 Tenth street, Portland, Ore., $24,500.

Columbia, S. C. — Constructing water works and sewer mains, to the Columbia Concrete Co., $5,300.

Elma, Wash. — Constructing pumping plant and distribution system, to Welton, Kibbe and Cochran, Portland, Ore., $14,806.

Seattle, Wash. — Constructing water mains and sewers in Dearborn street, to C. J. McHuth, Third avenue, North, Seattle, Wash., $36,888.

Tacoma, Wash.—Laying water mains, to Tony Fermo & John Cheva, $1,125.

Wacato, Wash. — Constructing water works plant complete, to the Fairbanks, Morse & Co., $7,497.

Kimball, W. Va.—Constructing water works system and electric light plant, to the Russell Co., Dayton, O., about $50,000.

CONTEMPLATED WORK.

Montgomery, Ala.—Water works improvements to cost about $20,000 are contemplated.

Madison, Fla.—A $30,000 bond issue for the purchase of the water works system and electric light plant has been voted.

Bainbridge, Ga.—A $10,000 bond issue for the installation of a water works system has been voted.

Sylvester, Ga.—A $20,000 bond issue for water works and sewer construction has been voted.

Salmon, Idaho.—A $50,000 bond issue for the purchase and improvement of the water works system has been voted.

Georgetown, Ill.—The installation of a water works system complete to cost about $10,000 is contemplated. H. O. Cook, city clerk.

Montgomery, Ill.—The installation of a water works plant to cost about $50,000 is contemplated.

Tampico, Ill.—Plans for a water works system to cost about $16,000 have been completed.

Owensville, Ind.—The installation of a water works system is contemplated.

Independence, Kan.—Extensive improvements to the water works system are contemplated. C. L. Wint, superintendent of water works.

Wichita, Kan.—The construction of a new water works plant, to cost about $1,000,000 is contemplated. Fred Alley, superintendent of water works.

Keokuk, Ia.—The Keokuk Water Works Company has been incorporated by W. J. Davis, M. L. Rogers and F. E. Robertson, Wilmington, Del. Capital stock, $95,000.

Williamsport, Md.—The installation of a water works system to cost $25,000 is contemplated. W. D. Byron, mayor.

Ashburnham, Mass.—Ivers Adams, Boston, Mass., has offered to install a complete water works system for the town.

Wazatah, Minn.—A $20,000 bond issue for a water works system has been voted.

Bozeman, Mont.—The construction of a water works system to cost about $35,000 is contemplated.

Manhattan, Mont.—A $25,000 bond issue for water works installation has been voted. The contract has been awarded to E. Lindstrom, Billings, Mont.

Hastings, Neb.—A $75,000 bond issue for the installation of a municipal water plant has been voted.

Hudson Falls, N. Y.—A $175,000 bond issue for the construction of a gravity water works system has been voted.

Irondequoit, N. Y.—The Rochester & Lake Ontario Water Co. has been granted a franchise and will construct water works improvements to cost about $100,000.

Black Mountain, N. C.—A $15,000 water supply system is contemplated.

West Asheville, N. C.—Water works extensions to cost about $20,000 are contemplated. J. J. Merrimon.

Malvern, O.—An ordinance providing $18,500 bond issue for the construction of a water works system has been passed.

McAlester, Okla.—A $50,000 bond issue for water works improvement has been voted.

Sutherlin, Ore.—A $30,000 bond issue for the construction of a gravity water system has been voted.

Ambridge, Pa.—The purchase of a water works plant from the Harmony Water Co., at $55,000, is contemplated.

Barnesboro, Pa.—The Citizens Water Co. will construct a small pumping station, storage reservoir, pipe line, etc. A. B. Crichton, Title and Trust building, Johnstown, Pa., engineer.

Brookeville, Pa.—The city has purchased the Brookeville Water Company plant for $116,500.

Etna, Pa.—A $25,000 bond issue for water works improvements has been voted.

Greencastle, Pa.—A $10,000 bond issue for water works improvement has been voted.

Somerset, Pa.—A charter has been granted to the Hooversville Water Co. for the construction of a 16,000,000 gallon reservoir. O. P. Thomas, Johnstown, Pa., engineer; Telford Lewis, president.

Chamberlain, S. D.—A $20,000 bond issue for the installation of a pumping station has been voted.

Lexington, Tenn.—Richard C. Huxton, of Memphis, Tenn., has been retained to prepare estimates on the construction of a water works and electric light plant, and a sewerage system for the city.

Memphis, Tenn.—Water works extensions to cost about $250,000 are contemplated.

Calvert, Tex.—Improvements to the water works and electric light plant to cost about $14,000 are contemplated by the Calvert Water, Ice and Electric Light Co.

Decatur, Tex.—An $18,000 bond issue for the purchase of the water works and electric light system has been voted.

Leonard, Tex.—A $10,000 bond issue for water works construction has been voted.

Mc. Vernon, Tex.—A $20,000 bond issue for water works improvement has been voted.

St. Albans, Vt.—A $60,000 bond issue for water works extension has been voted.

Barton Heights, Va.—A $20,000 bond issue for water works construction and sewerage and paving improvements has been voted.

Seattle, Wash.—The sum of $18,700 has been appropriated from the water fund for the construction of mains in Dearborn

street.

Spokane, Wash.—Alexander Lindsay, superintendent of water works, has prepared plans for high pressure water mains to cost about $200,000.

Kimball, W. Va.—A franchise has been granted to the Russell Co., Dayton, O., to construct a water works system to cost about $50,000.

Rowlesburg, W. Va.—The construction of a complete water works system is contemplated. George Hayes, town clerk.

Cowley, Wyo.—A $25,000 bond issue for water works and sewer improvements has been voted.

Medicine Hat, Alta, Can.—Water works extensions to cost $45,000 are contemplated.

BRIDGES.

BIDS REQUESTED.

San Luis Obispo, Cal.—Feb. 5, 10 a. m. Constructing steel highway bridge over the Santa Maria river. Certified check, 10 per cent. F. J. Rodrigues, clerk.

St. Jacob, Ill.—Feb. 10, 2 p. m. Constructing three reinforced concrete bridges in St. Jacob township. W. P. Sweeney, town clerk.

Brownstown, Ind.—Feb. 5, 1 p. m. Constructing bridge in Salt Creek township. H. W. Wacker, auditor.

Newport, Ind.—Feb. 5, 10 a. m. Constructing two bridges in Vermillion county. H. P. Payne, auditor.

Rensselaer, Ind.—Feb. 5, 2 p. m. Constructing four steel bridges in Kankakee township. Joseph C. Hammond, auditor.

Rushville, Ind.—Feb. 6, 2 p. m. Constructing two bridges on the Rush-Hancock line. Jesse M. Stone, auditor Rush county.

Winona, Minn.—April 9. Constructing an 80-ft. steel truss birdge. O. Leland, engineer.

Cincinnati, O.—Feb. 2, 12 m. Constructing a bridge over the Little Miami river under Specification No. 293. Bond, $5,000. Albert Reinhardt, clerk board of Hamilton county commissioners.

Portland, Ore.—Feb. 16, 4 p. m. Constructing a reinforced concrete viaduct over Sullivan's gulch at East Twenty-first street. A. L. Barber, city auditor.

Bellefourche, S. D.—Feb. 6. Constructing all steel bridges during 1912. Certified check, $100. E. C. Barr, county aufied check, $1,000. E. C. Barr, county auditor.

Bellefourche, S. D.—Feb. 6. Constructing all wooden bridges during 1912. Cerditor.

Chehalis, Wash.—March 4, 2 p. m. Constructing a 24-ft. reinforced concrete culvert. H. A. Swofford, auditor.

CONTRACTS AWARDED.

Imboden, Ark.—Constructing steel bridge across Eleven Points river at Birdell, to the Vincennes Bridge and Iron Co., Vincenes, Ind.

Lake Village, Ark.—Constructing steel and concrete bridge across the Bayou Macon, to the Vincennes Bridge and Iron Co., of Vincennes, Ind.

Jacksonville, Fla.—Constructing a concrete bridge over Goodby's lake, to W. C. Kierman & Co., $14,200.

Atkinson, Ill.—Constructing 140-ft. steel viaduct, to the Joliet Bridge and Iron Co., Joliet, Ill., $5,170.

Bloomington, Ill.—Constructing a bridge across the Illinois river in Tazwell county, to the Union Bridge and Iron Co., of Kansas City, Mo.

Jerseyville, Ill.—Constructing a bridge over Otter creek, to the Missouri Bridge and Iron Co., St. Louis, Mo.

Murphysboro, Ill.—Constructing a bridge across the Little Mundy river, to the Vincennes Bridge and Iron Co., Vincennes, Ind.

Springfield, Ill.—Constructing a bridge over Sugar Creek, to the Springfield Bridge and Iron Co., Springfield, Ill.

New Albany, Ind.—Constructing a bridge over the Little Indian creek at Lanesville, to the Vincennes Bridge Co., Vincennes, Ind.

Council Bluffs, Ia.—Grading and bridging on the Northwestern railway, to E. A. Wickham & Co., Council Bluffs, Ia., about $500,000.

Creston, Ia.—Furnishing material and constructing bridges in Union county, Ia., during 1912, to the Standard Bridge Co., Omaha, Neb., $16,730. Theodore S. Delay, county engineer.

Dennison, Ia.—Constructing bridges during 1912, to the Lana Construction Co., of Harlam, Ia.

Wichita, Kan.—Constructing a bridge over the Minnestah river, to the Wichita Construction Co., Wichita, Kan.

Baltimore, Md.—Constructing the Monroe street bridge over the Baltimore and Ohio railroad, to the McClintic-Marshall Co., of Pittsburg, Pa., $15,000.

Saginaw, Mich.—Constructing highway bridge on the Gratiot road, to the Joliet Bridge and Iron Co., Joliet, Ill., $10,650.

Duluth, Minn.—Constructing a 2-span bridge over the St. Louis river, to the Continental Bridge Co., $6,490.

Warrensburg, Mo.—Constructing 31 steel bridges in Johnson county, to the A. E. Shorthill Co., Marshalltown, Ia., $12,989.

Libby, Mont.—Constructing three bridges across the Kootenai river, to the Pacific Coast Bridge Co., Portland, Ore., $82,103.

York, Neb.—Constructing all steel and wood bridges in 1912, to the Western Bridge & Construction Co., Omaha, Neb.

Lima, O.—Constructing bridge in Woodlawn cemetery, to the Lima Stone Co., $6,720.

Massillon, O.—Constructing a Strauss Trunion Bascule Lift bridge over the Ohio canal at West Main street, to the Massillon Bridge and Structural Co., $9,930.

Toledo, O.—Constructing the new Cherry street bridge, to the Scherzer Rolling Lift Bridge Co., Chicago, Ill., $132,980.

Portland, Ore.—Constructing the steel work of the Broadway bridge, to the Pennsylvania Steel Co., of Steelton, Pa.

Oregon City, Ore.—Constructing a bridge at Sunnyside gulch, to the Coast Bridge Co., Portland, Ore., $17,965.

Roseburg, Ore.—Constructing the Browns Ferry, the Umpqua and Winston bridges, to the Portland Bridge Co., Portland, Ore., $42,000.

Brownsville, Pa.—Constructing the Monongahela river bridge at Brownsville, Pa., to the Drake & Stratton Co., Philadelphia, Pa.

Houston, Tex.—Constructing two reinforced concrete bridges on Houston avenue, to the Gulf Concrete Construction Co., Housston, Tex., $31,000.

Salt Lake City, Utah.—Constructing steel bridge across the Jordan river at North Ninth street, to A. A. Clark, $6,980.

Davenport, Wash.—The Coast Bridge Co. will construct six bridges in Lincoln county to cost $8,500.

Seattle, Wash.—Constructing reinforced concrete viaduct on Fremont avenue, to P. Ryan, Sullivan building, Seattle, Wash., $46,323.

Quebec, Can.—Removing old bridge and constructing new one over the Richelieu river, to J. S. Metcalf, Montreal, Que., $75,000.

CONTEMPLATED WORK.

Bakersfield, Cal.—County Surveyor Buffington has been authorized to construct a

concrete bridge over the Kern river at Chester avenue, to cost about $75,000.

Lodi, Cal.—The construction of a steel bridge across the Mokelumne river to cost about $35,000 is contemplated.

Scotia, Cal.—O. W. Simonson, engineer of the Pacific Lumber Co., has prepared plans for the construction of a steel bridge across the Eel river to cost about $148,000.

Willows, Cal.—Forest P. Boardman, professor of civil engineering, Nevada State University, has been retained as a consulting engineer on the construction of the Orland bridge over Stony creek at Stony Creek. Estimated cost, $150,000.

Yuba City, Cal.—The construction of a bridge across the Sacramento river at Meridian to cost $30,000 is contemplated by Sutter and Colusa counties.

Washington, D. C.—The construction of a bridge between Georgetown and Washington to cost about $275,000 is contemplated. P. T. Baily, Jr., engineer of bridges, District of Columbia.

Grand Junction, Colo.—County Surveyor Fisk has prepared plans for the construction of a bridge at Main street.

Bliss, Idaho.—F. Smith, Gooding, Idaho, has prepared plans for a bridge across the Snake river to cost about $11,000.

Gary, Ind.—The Lake county council has appropriated $75,000 for the construction of a bridge across the Calumet river at Indiana Harbor.

Richmond, Ind.—John Meuler, county engineer, is preparing plans for a bridge over the White river to cost about $100,000.

Toledo, Ill.—The construction of a reinforced concrete bridge to replace one destroyed by a cyclone is contemplated. Estimated cost, $12,000.

Topeka, Kan.—The construction of ten new bridges across the Shunganunda creek is contemplated.

Lynn, Mass.—Plans for a bridge across the Saugus river to cost $150,000 have been prepared by George I. Leland, city engineer.

Vassar, Mich.—The construction of a bridge over the Cass river to cost about $10,000 is contemplated. Perry Dean, town clerk.

Kansas City, Mo.—Louis R. Ash, city engineer, has submitted plans for the construction of a bridge over the McGee street traffic way, at Twenty-sixth street. Estimated cost, $15,000.

Minot, N. D.—Park improvements and road construction to cost about $30,000 are contemplated.

Dayton, O.—City Engineer Cellarius has prepared plans and specifications for the construction of a bridge at Keowee street to cost about $65,000.

Enid, Okla.—Bids for the construction of about 50 bridges and culverts have been rejected and new proposals will be asked.

Norristown, Pa.—The construction of a bridge across the Schuylkill river is contemplated. W. H. Wetherell.

Pawling, Pa.—The construction of a 3-span plate girder bridge over the Schuylkill river is contemplated by the commissioners of Chester and Montgomery counties.

McMinnville, Tenn.—The construction of a 565-ft. highway bridge over the Caney Fort river to cost about $15,000 is contemplated.

Comanche, Tex.—A $1,600,000 bond issue for the construction of roads and bridges in the county has been voted.

Orange, Tex.—A $200,000 bond issue for road construction has been voted.

Norfolk, Va.—W. T. Brooke, city engineer, has prepared plans for the construction of a bridge to cost about $450,000.

Aberdeen, Wash.—The construction of a $75,000 bridge to connect the city with South Aberdeen is contemplated.

Auburn, Wash.—The construction of a steel bridge to cost $10,000 is contemplated.

Chehalis, Wash.—Bowerman & McCloy, Central building, Seattle, Wash., have been instructed to prepare plans for a bridge over the Lewis river to cost about $60,000.

Mt. Vernon, Wash.—The construction of a steel bridge across the Skagit river to cost about $70,000 is contemplated.

Ocosta, Wash.—The construction of a new road and bridge between Ocosta and Westport to cost about $50,000 is contemplated.

Spokane, Wash.—The construction of four new county bridges to cost about $50,000 is contemplated. F. K. McBroom, chairman of county commissioners.

New London, Wis.—The construction of a bridge across the Wolf river to cost $15,000 is contemplated.

STREET LIGHTING.

CONTEMPLATED WORK.

Half Moon Bay, Cal.—The installation of a street lighting system is contemplated. Joseph H. Nash, clerk.

Los Angeles, Cal.—Lighting streets with arc lamps during 1912, to the Los Angeles Gas and Electric Corporation at $6.30 per arc lamp per month. The installation of 500 additional lights is contemplated.

Redwood City, Cal.—The installation of a street lighting system in the business district is contemplated.

Longmont, Colo.—The power plant of the Longmont Service Co. has been purchased by the city for the sum of $41,500. Extensions to the lighting system are planned.

Douglas, Ga.—A $15,000 bond issue for light and water improvements has been voted.

Peoria, Ill.—Mayor Woodruff is investigating the street lighting situation.

Anderson, Ind.—The city engineer is preparing plans for the installation of a new lighting system in the business district.

Allison, Ia.—A franchise has been granted for the installation of streets lights.

Carbon Cliff, Ia.—The construction of a municipal lighting plant is contemplated.

Columbus Junction, Ia.—The construction of an electric light plant and a street lighting system is contemplated.

Keokuk, Ia.—The Stone & Webster Co. is preparing plans for a new street lighting system.

Mobile, Ia.—Edgar Metcalf is planning the construction of an electric light plant.

Shenandoah, Ia.—A private lighting company has been granted a contract to install 155 tungsten lamps of 100-candle-power, and 20 3,600-candle-power lamps for the residence district.

Perry, Kan.—A $5,000 bond issue for the installation of a municipal electric light plant has been voted.

Island, Ky.—The installation of a street lighting system is contemplated.

Lexington, Ky.—The construction of a sewerage system and electric light plant and a water works system is contemplated.

Whitesburg, Ky.—E. P. Milling & Son, of Partridge, Ky., aer preparing plans for the construction of an electric light and power plant.

Lafayette, La.—Extensions to the municipal electric light and water works plant to cost about $50,000 are contemplated.

Biwabik, Minn.—The installation of an ornamental lighting system is contemplated.

Waterville, Minn.—A franchise has been granted to the Consumers Power Co., to furnish electricity for street lighting purposes.

Wazatah, Minn.—A $15,000 bond issue for an electric light plant has been voted.

Grand Rapids, Mich.—A committee appointed by the Business Men's Association

has reported in favor of the cluster system for lighting the business district. Meyer F. May, chairman Retail Merchants' Association.

Kalamazoo, Mich. — A special lighting committee has been appointed by Mayor Farrell, to secure data on a street lighting system.

Kansas City, Mo.—The question of adopting a design for an ornamental street lighting standard is being discussed by three committees, which are as follows: Commercial Club, H. R. Ennis, S. Jenkins, W. A. Repp; the city, Frank B. Askew, D. H. Talbot; The Kansas City Ad Club, L. H. Scurlock and W. M. Hawkins.

St. Louis, Mo.—A franchise has been granted to David E. Leahy, Richard J. Baldwin and Philip A. Smith, to furnish light and power to St. Ferdinand and Central township for a period of 50 years.

Ventnor, N. J.—The construction of a municipal lighting plant to cost about $75,000 is contemplated.

Millville, N. J.—The construction of a municipal electric light, heating and power plant is contemplated. C. F. Chard, city engineer.

Elmira, N. Y.—A contract with the Elmira Water, Light and Railroad Co., for furnishing arc lights for a period of five years, has been completed. Ornamental lights are contemplated. Harry M. Beardsly, superintendent.

Rochester, N. Y.—The installation of several ornamental lighting units for test services is contemplated.

Maiden, N. C.—The installation of an electric street lighting system is contemplated.

Milton, N. D.—The installation of an electric street lighting system is contemplated.

Alliance, O.—The construction of a municipal light plant is being urged.

Napoleon, O.—The installation of ornamental light in the business district is contemplated.

Springfield, O.—The city is contemplating street lighting improvements to cost about $60,000. J. J. Miller, mayor.

Oklahoma City, Okla.—The Chamber of Commerce is agitating the question of an ornamental lighting system. Walter B. Moore, secretary.

Wagoner, Okla.—The Benham Engineering Co., Oklahoma City, Okla., has prepared plans and estimates for water works and electric light extensions.

Easton, Pa.—The construction of a municipal lighting plant is contemplated.

Harrisburg, Pa.—The consolidation of the Paxtang Electrical Company and the Harrisburg Light, Heat and Power Co., is contemplated. An ornamental lighting system will probably be installed.

McKeesport, Pa.—The merchants have petitioned for the installation of 100 ornamental lighting standards. R. E. Stone, chairman of committee.

Olyphant, Pa.—John P. Kilellen Burgess, of Olyphant has recommended the installation of an ornamental lighting system.

Philadelphia, Pa.—The Philadelphia Electric Co. submitted the only bid for street lighting for the coming year, $1,336,287.

Pittsburg, Pa.—The installation of an ornamental street light on Federal street is contemplated.

Scranton, Pa.—A $5,000 increase in the appropriation for street light has been provided for the addition of 24 new arc lights.

Weatherly, Pa.—A $10,000 bond issue for the construction of a municipal light plant has been voted.

Wilkes Barre, Pa.—A franchise has been granted to the Wilkes Barre Light Co., for the furnishing of light and power.

Woodbury, Pa.—The construction of a municipal electric light plant is contemplated.

Lexington, Tenn.—Richard C. Huxton, of Memphis, Tenn., has been retained to prepare estimates on the construction of a water works and electric light plant, and a sewerage system for the city.

Decatur, Tex.—An $18,000 bond issue for the purchase of the water works and electric light system has been voted.

Oak Bay, B. C., Can.—The city clerk has been instructed to advertise for bids for an electric street lighting system.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

CONTRACTS AWARDED.

Hoboken, N. J.—Removing ashes and garbage, to the Central Contracting Co.

Ocean City, N. J.—Collecting garbage for a period of one year, to George W. Ernest.

Rochester, N. Y.—Collecting and disposing of garbage for a period of five years, to the Genesee Reduction Co., Rochester, N. Y., $77,500.

Philadelphia, Pa.—Disposing of garbage during 1912, to the Penn Reduction Co., $278,588.

CONTEMPLATED WORK.

Birmingham, Ala.—The construction of a garbage incinerator is contemplated.

Washington, D. C.—The District commissioners are contemplating the installation of a garbage reduction plant.

Cairo, Ill.—The bids for garbage removal have been rejected and new bids will be asked.

New Iberia, La.—George S. Earl, New Orleans, La., has been retained as consulting engineer on the construction of a garbage disposal plant.

Springfield, Mass.—The installation of a garbage disposal plant has been recommended. Edward H. Lathrop, mayor.

Dallastown, Pa.—The construction of a garbage disposal plant is contemplated. Jacob P. Grim, president of council.

FIRE APPARATUS.

BIDS REQUESTED.

Eureka, Cal.—Feb. 6, 8 p. m Furnishing one automobile combination chemical and hose wagon Certified check, 10 per cent City clerk.

CONTEMPLATED WORK.

New Decatur, Ala.—The purchase of an automobile fire engine is contemplated.

Hillsborough, Cal.—The purchase of an automobile fire engine is contemplated.

Pasadena, Cal.—The purchase of additional fire apparatus is contemplated.

Peoria, Ill.—The purchase of a combination fire engine and ladder truck is contemplated.

Springfield, Ill.—Fire Commissioner Davis has recommended the purchase of an automobile truck.

Sioux City, Ia.—The purchase of motor fire apparatus is contemplated. G. L. Kellogg, chief.

Independence, Kan.—A $32,000 bond issue for the purchase of motor fire apparatus and land for park purposes has been voted.

East Hampton, Mass.—Chief Kienle has recommended the installation of a fire alarm system.

Medford, Mass.—The purchase of two pieces of motor fire apparatus is contemplated.

Northampton, Mass.—Fire Chief Chase has recommended the purchase of an automobile fire truck.

Escanaba, Mich.—The purchase of a combination chemical and hose wagon is contemplated.

Lincoln, Neb.—The purchase of an automobile fire engine to cost about $8,000 is contemplated.

Beverly, N. J.—The extension of the sewer system is contemplated. George W. Abbis, chairman of sewerage commission.

Plainfield, N. J.—The purchase of an automobile hose wagon is contemplated. T. O. Doane, fire chief.

Summit, N. J.—The purchase of an automobile hose wagon has been recommended by the city council.

Buffalo, N. Y.—The purchase of a combination hose wagon and truck automobile propelled is contemplated.

New Rochele, N. Y.—The purchase of a motor fire engine is contemplated.

Niagara Falls, N. Y.—A $14,500 bond issue for fire apparatus has been sold.

Cincinnati, O.—The purchase of an automobile truck and 3,000 ft. of hose has been recommended.

Dayton, O.—The purchase of three automobile fire wagons and a chief's automobile has been recommended.

Lakewood, O.—A $15,000 bond issue for the purchase of fire apparatus and material has been voted.

Norwalk, O.—The purchase of an automobile fire engine is contemplated.

Washington Court House, O.—The purchase of new fire apparatus is contemplated. B. H. Millikan, president of council.

Allentown, Pa.—The purchase of an automobile combination wagon for the Pioneer Fire Company is contemplated.

Beaver, Pa.—The purchase of a new automobile fire truck is contemplated.

Ellwood City, Pa.—The purchase of motor fire apparatus is contemplated.

McKeesport, Pa.—The purchase of motor fire apparatus is contemplated.

Scranton, Pa.—The purchase of motor fire apparatus is contemplated.

Fort Worth, Tex.—Chief Biddeker has recommended the purchase of an automobile fire engine and other automobile propelled aparatus.

St. Johnsbury, Vt.—The purchase of an automobile combination fire truck is contemplated.

Aberdeen, Wash.—An appropriation of $8,500 for the purchase of an automobile combination pumping engine and hose wagon has been voted.

TOO LATE FOR CLASSIFICATION.

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Grove Hill, Ala.—Feb. 7, 2 p. m. Grading and resurfacing with sand clay about 6 miles of state aid road. W. S. Keller, Montgomery, Ala., state highway engineer.

Daytona, Fla.—Feb. 7, 2 p. m. Improving road in St. Lucie county. C. M. Rogers, city engineer.

CONTRACTS AWARDED.

Little Rock, Ark.—Paving Rector avenue with brick, and Third street with creosoted wood block, to Geo. B. Swift & Co., Chicago, Ill.

Portland, Ind.—Constructing stone road in Richmond township, to Nicoson & Pierce, Alexandria, Ind., $15,260.

Hamilton, Ala.—Constructing road from Hamilton to Guym, to A. F. Beardon, Birmingham, Ala., $17,350.

CONTEMPLATED WORK.

Sanford, N. C.—A $100,000 bond issue for the construction of roads in Lee county has been voted.

Schenectady, N. Y.—The construction of a municipal paving plant to cost about $15,000 is contemplated.

Freeport, Ill.—The paving of Float, Benton and Delaware streets with brick to cost about $25,000 is contemplated.

Hendersonville, N. C.—A $24,000 bond issue for the paving of Main street and Sixth avenue with asphalt has been voted.

SEWERS.

BIDS REQUESTED.

New Philadelphia, O.—Feb. 8. Constructing sanitary sewer and syphon line. H. B. Fribley, director of public service.

Salem, O.—Feb. 14, 12 m. Constructing a sewage disposal plant including the following: 22,000 cu. yds. earth excavation, certified check, $200; 623 yds. concrete and masonry work, 416 sq. yds. brick paving; two gate chambers; one small pump house, certified check, $200; filter material, pipe, ironwork, valves and setting same; 4,100 yds. gravel, 20,900 yds. sand, 8,424 lin. ft. sewer and drain pipe, wooden troughs for filter and sludge bed, certified check, $200; steel rods, iron pipe, valves, sewage siphons, and metal work. B. H. Rummell, director of public service; L. E. Phatin, 1017 Frick building, Pittsburg, Pa., engineer.

CONTRACTS AWARDED.

Seneca, Kan.—Constructing complete sewerage system, including 12 miles of pipe line and a disposal plant, to Wm. F. Plummer Co., Springfield, Mo., $62,000.

Springfield, Mo.—Alexander Potter, 114 Liberty street, New York, N. Y., is preparing plans and specifications for a sewage disposal plant.

WATER WORKS.

CONTEMPLATED WORK.

Berryville, Ark.—The Will F. Plummer Co., of Springfield, Mo., has been retained to prepare plans and estimates for the construction of a complete water works system.

BRIDGES.

BIDS REQUESTED.

Chillicothe, O.—Feb. 12, 12 m. Constructing concrete substructure for the Downs bridge on the Sulphur Springs road. Certified check, $100. Robert D. Alexander, auditor.

Chillicothe, O.—Feb. 19, 12 m. Constructing reinforced concrete culvert near Mattaville in Concord township. Certified check, $100. Robert D. Alexander, auditor.

Cincinnati, O.—Feb. 16, 12 m. Constructing concrete bridge on River road under Specification No. 230. Certified check, $1,000. Albert Reinhardt, clerk board of Hamilton county commissioners.

CONTEMPLATED WORK.

Philadelphia, Pa.—Constructing roadway and bridge across Barnegat Bay, New Jersey from Manahawken to Long Beach, to the General Contracting and Engineering Co., New York City, $75,000.

Milwaukee, Wis.—A $175,000 bond issue for a bridge at Buffalo street has been voted.

GARBAGE

BIDS REQUESTED.

Millvale, Pa.—Feb. 6, 3 p. m. Collecting and removing garbage for year ending January, 1913. Wm. Fox, president of council; H. H. Dixon, clerk; James Houlahan, burgess.